Trade, Skill-Upgrading and Wages in Developing Economies

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1. Introduction

Empirical evidence overwhelmingly suggests that trade liberalization is associated with rising skill premiums, both in developed and developing economies.[1] This evidence is in stark contrast to the intuition that comes from the Stolper-Sameulson (SS) theorem. The SS theorem indicates that the effect on skill premium will vary deepening of the endowment pattern of the country, and should fall for unskilled labour abundant countries. The fact that a number empirical studies find that trade liberalization in developing economies is associated with rising inequality is therefore a puzzle with important implications for policy reforms in these emerging economies.

As discussed by Goldberg and Pavcnik (2007) the Stolper-Sameulson theorem however, is difficult to test directly using available data and the effects of trade and technology change can be difficult to independently identify. Among the various attempts to understand this is the possibility that Stolper-Sameulson effects, if present, may operate with long lags.

The aim of this paper is also to consider the effects of trade liberalization on skill premiums in several developing economies - specifically China and Vietnam. Thus we are interested in whether, as might be inferred from a Stolper-Samuelson model trade liberalization in developing economies raises unskilled wages relative to skilled wages.[2] We extend the existing CGE literature by considering a model with endogenous physical and human capital accumulation. This allows us to address a widely acknowledged gap in the literature relating to the timing of trade wage relationships and lags in response time.

We find that trade linearization, or more specifically tariff elimination, has very different impacts in the long run and in the short run. Allowing for endogenous factor supply responses, and in particular for skill accumulation, we find that in the long run lower commodity prices may also reduce investment costs and this leads to capital deepening, including skill accumulation. The increase in skilled labour per workers produces a long run fall in the skill premium. Over a transition however an increase in the skill premium is needed to sustain the investment in

[1] Goldberg and Pavcnik (2007) cite the econometric evidence and suggest that trade liberalization in developing economies also tends to be associated with rising, rather than falling, skill premiums. Goldberg and Pavcnik (2007) also discuss the extensive literature exists which aims to reconcile theory and evidence. Most of the literature focuses on problems of interpretation of the Stolper-Sameulson, time-lags and possible effects of induced skill biased technology effects.

[2] Trade liberalization has been found to increase the skill premium increased in Mexico, Chile,and Costa Rica (Hanson and Harrison, 1995, 1999a,b; Revenga,1997; Robbins, 1995, 1996)

education. Thus effect of trade liberalization is to reduce the skill premium in the long run, increase it in the short run and, produce a large increase in the stock of skilled labour per worker.

We illustrate this mechanism using models of China and Vietnam. In each case the case of unilateral trade liberalization and report the path of skilled and unskilled wages. In both case the skill premium rises on impact and remains positive for more than 40 years. In the very long run these are reversed with the increased stock of skilled labour reducing the skill premium below its original level. Under all reasonable rates of convergence however this takes more than 50 years and hence would not be observed in the data sets used in the empirical literature on trade liberalization.

2. Background

The debate over the consequences of economic integration and globalization on wage and incomes has been one of the most enduring economic issues, Examples include Berman Bound and Griliches, 1994, Wood 1998, Krugman 2000, Haskel, and Slaughter, 2002) Falvey, 1999, Leamer, 2000; Neary, 2002. As discussed by Goldberg and Pavcnik (2007) the general equilibrium nature of the Hecksher-Ohlin model makes it difficult to compare with data and a direct link between trade and factor prices is difficult to identify. Nevertheless it is somewhat curious that the available evidence suggests that trade liberalization is associated with increases in the skill premium in developing economies.

An alternative approach to assessing the impact of trade liberization on relative wage incomes is to use Computable General Equilibrium (CGE) models. CGE studies tend to confirm the econometric results that trade liberalization and export expansion in industrialization economies has also raised skill premiums in developed economies (Winchester, 2007). There are a also number of CGE studies looking specific trade policy reforms in developing economies on poverty. The focus of the literature is on the absolute, rather than relative, changes in incomes. Moreover these studies tend to focus on determinants of poverty, of which the wage rate in only one factor, with taxes, transfers, food prices and employment opportunities also being very important. Perhaps because of the There are few CGE studies that explicitly look at the effect of trade liberalization in developing economies on the trade wages issues.[3]

[3] There are even fewer studies of the effects of skill-upgrading. Pavcnik (2003) explores this issue with respect to technology change and foreign investment.

There are also very few CGE studies that have considered the effects factor accumulation in the context of the trade wages debate.[4] Clearly however the skill premium and education investment must be related over time.

A number of theoretical studies have explored this issue. Long, Riezman and Soubeyran, (2007) for example show that a model of skill accumulation can potentially reverse the gains from trade in developing economies due to skill specific human capital. A more conventional Hecksher-Ohlin style model with factor mobility is described by Findlay and Kierzkowski (1983). In their model in which there are two final goods produced by skilled and unskilled labour. Education is an intermediate good which also employs a specific capital good. They show that trade liberalization has no long run effect on the skill premium but induces skill accumulation in the skilled labour abundant country and de-accumulation in the unskilled labour abundant country. As they argue the incentive to acquire skills is reduced if the goods requiring skills more intensively can he imported more cheaply. Thus trade tends to magnify the initial endowment differences. Finally because the skill premium remains constant and the gains from trade in the skill intensive economy accrue to the owners of education specific capital in the long run. They do not however describe the transitional effects.

3. A Model of Skill Formation

To consider the effect of trade liberalization on human capital accumulation we first consider a simple aggregate model of human capital accumulation. Latter we will integrate this with multi-sector general equilibrium model.

Let the working population, or labour force, at time *t* be denoted P_t . The net increase in the labour force is

$$P_{t+1} = (1 + b_t - d_t)P_t \qquad (1.)$$

where b_t is the birth rate, d_t is the retirement rate. At a point in time the labour force is defined in terms of skilled labour, *LS*, unskilled labour *LU*, and students, *H*.

$$P_t = LS_t + LU_t + H_t \qquad (2.)$$

[4] Studies looking at Poverty and trade issues include Hertel, et al (2004). and other papers are surveyed in Winters McCulloch and McKay (2004). The focus on the literature is the decomposition of household types and consumption patterns according to different income groups.

The stock of skilled labour depends on past schooling decisions by unskilled workers. There is an endogenous flow of students graduating each year and entering the skilled labour force. Denoting this flow on skilled entrants as E_t, we have $E_t = H_t / \zeta$ where H_t is the stock of students, E_t is the flow of graduates and ζ is number of years in school. The updating equation for skilled labour is then

$$LS_{t+1} = LS_{t_t} + H_t / \zeta - d\ LS_t \qquad (3.)$$

The optimal pattern of investment in schooling is chosen by a representative household who maximizes the present value of total labour incomes subject to on the job training costs faced by skilled labour. This is given by

$$\sum_{t=0}^{\infty} \frac{1}{1+\rho^{t_t}} \left[u_{s,t}\ LS_t - u_t\ C(H_t, LS_t) + u_{u,t}\ LU_t - p_{e,t}\ A_{et}\ H_t \right] \qquad (4.)$$

where $u_{s,t}$ is the after tax skilled wage, $u_{u,t}$ is the after tax unskilled wage, $p_{e,t}$ is the price of education, A_{et} is a technology parameter determining the quantity of education required to produce a skilled graduate, ρ is the households rate of time preference, and $C(H_t, LS_t)$, $C_H(H_t, LS_t) > 0$ and $C_{LS}(H_t, LS_t) < 0$, is a training cost function which says that it is costly to raise the flow of new entrants (indicated by the stock of students *H*) relative to the existing pool of skilled workers.

We assume that the adjustment costs function takes the form

$$C = \frac{\alpha (H_t - b\zeta\ LS_t)^2}{2\ LS_t} \qquad (5.)$$

Thus the size of the training costs depend on deviations of *H* from the reference level $b\zeta\ LS$, which, as discussed below is the steady state stock of students.

The Household's objective is to maximize (4.) subject to (1.), (2.) and (3.). The Lagrangian is

$$\sum_{t=0}^{\infty} \frac{1}{1+\rho^{t}} \left[u_{s,t}\ LS_t(1 - C(H_t, LS_t)) + u_{s,t}\ LU_t - p_{e,t}\ A_{e,t}\ H_t - \hat{\Pi}_t (LS_{t+1} - E_t - \gamma M_t - (1-d) LS_t \right]$$

where $p_{e,t}\ A_{e,t}\ H_t$ is the direct cost of schooling. The household takes the relevant prices and wage rates as given. These are determined in a general equilibrium model taking account of inter-temporal preferences, optimal investment decisions and factor supplies, trade flows and world prices.

The first order conditions associated with the preceding Lagrangian are:

$$-u_{s,t_t} C_H(H_t, LS_t)\zeta - u_{u,t_t}\zeta - p_{e,t} A_{e,t}\zeta + \hat{\Pi}_t = 0 \qquad (6.)$$

$$-\hat{\Pi}_t + \frac{1}{1+\rho}\left(u_{s,t+1_t}(1 - C_{LS}(H_{t+1}, LS_{t+1})) - u_{u,t+1_t} + (1-d)\hat{\Pi}_{t+1}\right) = 0 \qquad (7.)$$

Equation (5.) says that the shadow price of a unit of skilled labour is just equal to the sum of the maginal costs of schooling, that is variable cost of education per unit, the opportunity cost and the marginal adjustment cost. Equation (5.)

From (5.) the marginal adjustment cost function is

$$C_H = \alpha(H / LS - b\zeta) \qquad (8.)$$

Rearranging the first FOC gives,

$$\frac{\hat{\Pi}_t}{\zeta} = u_{s,t}\, C_H + u_{u,t} + p_e\, A_{e,t} \qquad (9.)$$

Now we substitute for C_H to get,

$$\frac{H_t}{LS_t} = \frac{\hat{\Pi}_t / \zeta - u_{u,t} - p_{e,t}\, A_{e,t}}{\alpha\, u_{s,t}} + b\zeta \qquad (10.)$$

which is the demand for schooling function. It can be seen that the demand for schooling relative to the existing stock of skilled labour depends upon the shadow price of skilled labour relative to the cost of schooling, which include the direct costs, $p_{e,t}\, A_{e,t}$, and the opportunity cost $u_{u,t}$. Equation (10.) shows thus shows that variations in demand for students will depend on the asset value of skilled labour relative to the current wage rate $\hat{\Pi}_t / u_{s,t}$, the inverse skill premium, $u_{u,t} / u_{s,t}$, and the direct costs of education.

3.1 Balanced Growth path

We define a balanced growth path as a path all stocks are growing at the rate of effective population $(1+n)(1+g)$. Note first that the ratio of skilled labour to population LS_t / P_t must be constant on steady state and hence LS_t must grow at the long run population growth rate. Dividing (3.) by LS_t and re-arranging gives

$$\frac{H}{LS} = b\zeta\,. \qquad (11.)$$

This confirms our assertion above in discussing (4.) that on a steady state the growth rate of human capital, *LS*, from migration and education must be constant multiple of the birth rate.[5]

The wage rates, $u_{u,t}$ $u_{u,t}$, and shadow price $\hat{\Pi}_t$ must be growing at the growth rate of productivity, $(1+g)$ on the balanced growth path. In view of this it is useful to redefine these wage rates and shadow prices in terms of efficiency units that will be stationary. To this end define an efficiency adjusted shadow price of skilled labour as $\Pi \equiv \hat{\Pi}_t / A_{e,t_t}$. Likewise let $u_{u,t} = \hat{u}_{u,t} / A_{u,t}$ and $u_{s,t} = \hat{u}_{s,t} / A_{s,t}$. In terms of these efficiency unit adjusted shadow prices (7.) becomes

$$A_{s,t}\,\Pi_t(1+\rho) = \left(A_{s,t+1}\,u_{s,t+1_t}(1-C_{LS}(\zeta\,E_{t+1}, LS_{t+1})) - A_{u,t+1}\,u_{u,t+1_t} + (1-d)A_{s,t+1}\,\Pi_{t+1}\right) \qquad (12.)$$

On a steady state we have $\Pi_t = \Pi_{t+1}$, $u_{s,t} = u_{s,t+1}$, $u_{u,t} = u_{u,t+1}$ and $C_{LS} = 0$. Let the ratio of efficiency units of unskilled to skilled labour be $A_u / A_s \equiv \tau$. Hence

$$\Pi\ (1+\rho) = (1+g)\,u_s - \tau\,u_u + (1-d)(1+g)\,\Pi$$

Re-arranging gives

$$\Pi = \frac{1+g}{(1+\rho)-(1-d)(1+g)}\left[u_s - \tau\,u_u\right] \qquad (13.)$$

This shows that the effective shadow price has the interpretation, loosely, of the discounted value of the stream of skill premia.

Likewise on a balanced path (9.) becomes

$$\Pi = \zeta(\tau\,u_u + p_e) \qquad (14.)$$

Which shows that the shadow price is related to the opportunity and direct costs of schooling. Combining these expressions gives the steady state relationship between the skill premium and the price of education.

$$\Delta(u_s - u_u\,\tau) = \zeta\,(p_e + u_u\,\tau) \qquad (15.)$$

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[5] This holds irrespective of the nature of the dynamics, ie whether they are forward looking or recursive. Essentially any model of skill accumulation that permits a steady state, must exhibit a similar relationship between skilled labour inflows and education, as long as both types of skilled labour produce the same factor services.

where $\Delta \equiv (1+g)/(1+\rho) - (1-d)(1+g)$. Thus the balanced path value of the skill premium depends on the number of years of schooling it takes to be become "skilled" and the market price of education, which reflects firm's unit costs and government taxes and subsidies.

Dividing by the unskilled wage gives

$$\Delta(u_s / u_u - \tau) = \zeta\ (p_e / u_u + \tau) \tag{16.}$$

Thus on a balanced growth path the skill premium u_s / u_u is proportional to the ratio of education costs to unskilled wage, p_e / u_u .This shows the critical role of investment costs in a dynamic model. The skill premium will depend on the direct costs of acquiring skilled labour. If for example trade liberalization does not change the direct costs of schooling then the skill premium will be constant. Of course it remains an open question as to how trade liberalization and resulting factor price and factor accumulation will affect education costs. In the model skilled wages are not uniquely determined by the prices of traded goods.

3.2 Supply side

On the supply side education services are produced by a non-traded competitive industry which supplies these services at a supply price p_e. Education can be treated as a non-traded good or traded good. The production function for domestic education services is given by

$$y_e = \min\left[M^e, f^e(v^e)\right] \tag{17.}$$

This production function is constant returns in the vector of domestic factors v^e and in intermediate good input aggregate M^e which is defined by

$$M^i = \min_{j=1,..n}\left[\frac{Y_{ji}}{a_{ji}}\right] \tag{18.}$$

Dual to the value added function $f^e(v^e)$ is a unit cost function $c^e(w)$. Factor demands are given by Shepherd's lemma applied to $c^e(w)$, which are then multiplied by the level of educational output y_e to give total demand. Note that in equilibrium price equal cost in the education sector so that

$$p_e = (1-s^e)\left(c^e(w) + \sum_j a_{je} p^j\right) \tag{19.}$$

where the demand price p_e is net of any education subsidy provided at rate s^e. The total amount of educational output is given by

$$y_e = A_e H \qquad (20.)$$

Thus the output of the educational sector is measured in units of person schooling per year (or students per year) efficiency adjusted. As economy wide technical change occurs more schooling output is required to produce skilled workers. This is to conform with the dynamic equations relating changes in schooling into units of skilled labour supply.

4. Calibration

We calibrate the model using the steady-state constraints. The main inputs into calibration are: demographic data on labour force growth; an assumed number of years of higher education schooling, ζ; observed skilled labour stock ratio, *LS/P;* an observed student stock *H/P;* as well as the values of total higher education spending and gross skilled and unskilled labour incomes and average tax rates on skilled and unskilled labour based on income tax schedules.

A key ratio is the education investment rate *H/LS.* This is taken from available data on higher education student numbers, *H/P* and *LS/P* and skilled labour stocks. Likewise given a value for population and using equation (2.) we can readily determine *LU/P*. Given labour incomes $w_s L_s$ and $w_u L_u$ the gives the observed steady state before tax wage rates w_s, w_u and hence also the implied skill premium w_s / w_u. Given income tax rates also the after tax wages $u_s = (1-t_s)w_s$, $u_u = (1-t_u)w_u$. Given normalization for relative productivity ratios, τ, equation (16.) can then be used to determine the demand price of education p_e. This is the is the implied price that households are willing to pay given observed skill premiums and tax rates assuming a steady state growth path. Using equation (14.) then gives the steady state shadow price $\Pi = \zeta(\tau u_u + p_s)$.

These values need however to be reconciled with other parts of the model. From (11.) the observed value of *H/LS* implies a value labour market entry, or "birth rate" *b,* for a given number of years of education ζ. If the economy has an expanding skilled labour force or changing birth rate then this implied steady state rate will differ from the observed rate in the data. Likewise, given that growth is simply *b-d*, the retirement rate, *d*, can be determined from the growth rate of population and the implied value of *b*. The remaining parameter is the discount rate ρ, which is simply taken as 0.06.

On the supply side of the model we begin with an estimate of total education spending as a fraction of GDP. This yields an estimate of the value of gross education output. We think of the physical output of the education sector as the stock of students, *H*. Hence dividing The gross value of

output by *H* givens an implied supply price of students. The difference between this supply price and the demand price then determines an implied education subsidy level using equation (19.). The resulting values for China and Vietnam from this Calibration process are shown in the Appendix.

5. Trade Liberalization and the Skill Premium

The preceding theory shows that there is a long run relationship between skill premium and the cost of education. We have not shown how trade liberalization will affect these variables. To consider the dynamic effects we present the results of two sets of simulations for China and Vietnam. Both countries are developing economies and have a strong unskilled labour content in their export patterns. In both cases we consider the effect of unilateral trade liberalization, though the signs of the variables of interest, skill-premia wage rates are unchanged if we consider bilateral tariff reductions also. The base 2000 tariff schedules for each country are taken from GTAP data and are reported in Table 1. The average tariff rate is approximately 17 percent for Vietnam and 13 percent for China. In both cases tariffs are largest in Agriculture.

First we consider the long run effects of tariff liberalization which are presented in Table 2. It can be seen that the liberalization has a much more dramatic effect in Vietnam. In both cases however trade liberalization generates strong growth in unskilled wages. In particular unskilled wages rise 12% in Vietnam. Skilled wages also rise but not as much and the result is a fall in the skill premium of approximately 3% in both Vietnam and China.

The overwhelming result however is increased investment in education. In Vietnam there is a a 41.3 percent increase in the long run stock of skilled labour and the increase in China is 12.9 percent. Thus trade liberalization in both countries has a strong effect on skill upgrading, particularly in Vietnam.

This strong “up-skilling” effect is in addition to strong wage growth for skilled labour and unskilled labour. Thus in terms of labour incomes trade liberalization tends to raise both incomes of the skilled and unskilled in the long run. The issue remains as to how this increase in skilled labour comes about. The accumulation of skilled labour, through attendance in education institutions, depends not on the absolute level of skilled wages but the skill premium. In order to increase the balanced path stock of skilled labour there must not have been only an increase in the rate of investment in education but a transition where the level of *H/LS* rises above the steady state level, which is fixed at the value $b\zeta$ by equation (10.). Thus if skilled labour per worker, *LS/P*,

has increased over a transition then the "investment rate" *H/LS* must have risen above the steady-state rate ratio $b\zeta$.

From equation (10.) however this can only happen if $\hat{\Pi}_t / \zeta > u_{u,t} + p_{e,t} A_{e,t}$ which suggests that the skill premium must have been higher than the steady state level over the transition.[6] Intuitively since the steady state rate of schooling is just sufficient to maintain the current ratio of skilled to unskilled labour, the fact that *LS/P* has risen implies that *H/LS* must have exceeded the steady state level over the transition. Thus the issue remains however as to how much the skill premium rises and for how long. For this we require numerical simulations of the transition path. The solution path is the perfect foresight path that satisfies the first order conditions and reaches the steady state. As practical mater we approximate this infinite horizon problem with a solution that reaches the steady state after 100 years. We solve the model using numerical methods developed by Wilcoxin (1988).

Figure 1 reports key variables over the transition for Vietnam. It shows first that on impact the skilled wage rate rises by more than 20% with little change in the unskilled wage initially. Unskilled wages eventually rise but there is little impact until 20 years past the initial reform. Thus in stark contrast to the long results where there is a small fall in the skill premium, in the short run the skill premium rises by approximately 20 percent.

The demand for skilled labour initially comes mostly from the *Low-tech* manufacturing sector and the *Education* sector. This reflects the increased demand for machinery and equipment capital, and the investment demand for skilled labour. Thus far from trade liberalization reducing inequality, we find that the investment demands, particularly from the low-tech and education sectors raise the skill premium substantially. Moreover it can be seen that this effect lasts for a long time – over 50 years.

Thus we see that effect on the demand for skilled labour is positive for both types of labour but more so for skilled labour. Returns to land and resources fall however. Second we see that although there is substantial human capital accumulation, the transition is very long thus there is a large – 15% to 25% – increase in the skill premium over the two decades following trade liberalization.

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[6] From equation (7.) Π_t can rise above its balanced path level only if the gap between the net marginal product of skilled labour and the marginal product of unskilled labour rises. That is the difference $u_{s,t+1_t}(1-C_{LS}) - u_{u,t+1_t}$ becomes large.

Turning to China in Figure 2 we see that the pattern is very similar but the magnitude of effects in more moderate. Again skilled wages jump on impact while unskilled wage impacts only rise as capital and skilled labour accumulate. Again there is initially a substantial skill premium initially which persists for many decades.

5. 1 Industry Composition Effects

Both the long run and short run results this show a strong increase in labour demand from trade linearization. The labour demand growth is stronger for skilled workers. This is perhaps surprising given the Stolper-Sameulson intuition, that both China and Vietnam would be unskilled labour abundant countries. It is however consistent with the empirical studies that find increasing skill premiums in developing economies associated with trade liberalization episodes. To help understand the sources of this labour demand we consider industry effects and also capital-skill complementarities in production.

First consider the labour demand by different industries. There are two basic sources of demand for skilled labour. First there is the increased investment demand as the each economy accumulates skilled labour and capital. Skilled labour is required to build new capital and in particular, as teachers and administrators in education sector. Second trade liberalization leads to large changes in the composition of output. As in the Stolper-Sameulson theorem these composition effects result in a shift in aggregate labour demand.

First, as shown in Tables 3 and 4, tariff removal results in a large expansion of the *Low-tech* sector in Vietnam and a large expansion of *Durables* in China. Though these are not the most skill intensive sectors in each region they are both more skill intensive than *Agriculture* which contracts in both regions. The bar charts in Figures 3 and 4 show the impact of these output changes on skilled labour demand. They show the change in the share of skilled labour employment in each sector - both on impact and in the long run. On impact it can be seen that there is an increased share of skilled labour employed in the *Education* sector which reflects the investment demand from a stream of future anticipated higher skill premiums rates and lower education costs.[7] In the long run, however, Figures 3 and 4 show that the demand for skilled labour is driven by the *Lowtech* sector in Vietnam and by *Durables* in China - which both substantially increase their

[7] An interesting aspect of the Vietnam results is that the initial expansion of education demand and hence demand for skilled labour from that sector appears to crowd out other skill intensive sectors such as traded services and durables, which contract on impact, but expand once the supply of skilled labour expands.

shares of the growing skilled labour supply. The demand in these sectors thus matches the pattern of output composition change following trade liberalization.

5. 2 Capital-Skill Complementarity.

In addition to the accumulation of skilled labour there is also substantial accumulation of machinery and equipment capital and structural capital in both Vietnam and China. Some of the recent trade and wage literature has focused on capital–skill complementarity as a source of inequality in developed economies (Krusell et al 2000). To the extent that trade liberalization raises the supply of capital this accumulation of physical capital may also raise the marginal product skilled labour.

The preceding results assume a nested CES cost function for all sectors with skilled labour and other types of capital in a lower nest aggregate, and labour and other fixed factors in the upper level. We take the elasticity parameters from Krusell et al (2000) to be 1 2/3 for the upper next and 2/3 for the lower nest. This generates capital-skill complementarity in the Hicks-Allen sense. That is, an increase in the price of capital reduces the demand for skilled labour, or vice versa. More importantly from our perspective it generates capital-skill complementarity in the production sense: That is a rise in the supply of capital will have a strong positive impact on the marginal product of skilled labour.

To what extent is the rise in the skill premium due to this assumed capital-skill complementarity. To address this issue we resolve the model assuming a constant elasticity of substitution in all CES cost functions of 1.1. Thus the technology is approximately Cobb-Douglas and hence there is no capital-skill complimentarily in the Hicks-Allen sense. Nevertheless it should be noted that even with Cobb-Douglas, or iso-elastic technology, there remains capital-skill complementarity in the production sense. Given the CES production functions however the effect of accumulation on the marginal product of skilled and unskilled labour very similar. Figure 7 shows that in this case there is less accumulation of skilled labour under the CES case than with capital skill complimentarily, however the difference is small. The skill premium on impact is approximately the same in both cases, with the main difference being that under CES the skill premium increase is eliminated after 30 years rather than 50 years. Hence capital skill complimentarily is not an important source of rise in the skill premium.[8]

[8] Since the skill premium rises on impact this cannot be attributed to capital skill complementarity, though in principle it could be due to the anticipated effects of future accumulation on the future rental stream from skilled labour.

5. Conclusion

CGE studies have been widely used to look at the relationship between trade liberalization on welfare, particularly in recent years they have been used to look at the impact of trade on poverty levels in less developed countries. The trade-wages debate has raised a broader question however over the role of Stolper-Sameulson effects in generating wage increases in developing economies. I this paper we use a dynamic CGE model to study the impact of trade liberalization in two developing economies on relative wages.

We find that the dynamics are very important. The removal of tariffs in both China and Vietnam results in a large amount of skill accumulation in the medium term and a large increase in the skill premium in the short term. This last result is consistent with the econometrics literature which finds that trade liberalization is associated with increases in inequality.

The results, however, also provide some insights into this rise in inequality. The results here suggest that rising inequality associated with trade liberalization may be due to the rise in skilled labour demand from intermediate manufacturing sectors which, though not the most skill labour intensive, are still skill intensive relative to Agriculture. They show that these effects on inequality are associated with rising wages of unskilled workers and a large amount of skill upgrading. Thus the observed rises in inequality in some developing countries may nevertheless be associated with very strong positive labour market outcomes for both skilled and less skilled workers.

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Table 1: Income Share Parameters For Vietnam

	Agriculture	*Minerals*	*Lowtech*	*Intermediate Manu*	*Durables*	*Traded Serives*
Chinese Tariffs Against USA	0.23	0.08	0.20	0.12	0.13	0.07
Chinese Traiffs Againt ROW	0.34	0.01	0.11	0.11	0.12	0.07
	Agriculture and Minerals	*Rice*	*Lowtech*	*Intermediate Manu*	*Durables*	*Traded Serives*
Vietnamese Tariffs Against Asia	0.56	0.17	0.14	0.08	0.18	0.23
Vietnamese Traiffs Againt ROW	0.26	0.14	0.23	0.07	0.21	0.23

Table 2: Income Share Parameters For Vietnam

	Skilled Lab Share	*Unskilled Lab Share*	*Other Factors Share*
Agriculture and Minerals	0.02	0.30	0.67
Rice	0.01	0.42	0.57
Lowtech	0.13	0.40	0.47
Intermediate Manu	0.14	0.37	0.49
Durables	0.16	0.42	0.43
Traded_Serives	0.28	0.26	0.46
Construction	0.15	0.35	0.50
Non Traded Services	0.13	0.36	0.51
Public	0.69	0.22	0.09
House	0.00	0.04	0.96
Education	0.66	0.28	0.06

Table 3: Income Share Parameters For China

	Skilled Lab Share	*Unskilled Lab Share*	*Other Factors Share*
Agriculture	0.01	0.50	0.49
Minerals	0.02	0.12	0.86
Lowtech	0.06	0.38	0.56
Intermediate Manu	0.06	0.32	0.62
Durables	0.05	0.27	0.68
Traded_Serives	0.11	0.16	0.73
Construction	0.07	0.33	0.60
Non Traded Services	0.06	0.25	0.69
Public	0.39	0.26	0.35
House	0.00	0.05	0.95
Education	0.54	0.23	0.23

Table 4: Summary Long Run Results for Unilateral Trade Liberalization (% change)

		Vietnam	*China*
GDP	y	24.7	7.6
Consumption per worker	c	6.4	1.1
Skilled Wages	u_s	9.2	2.6
Unskilled wages	u_u	12.2	5.3
Skill Premium	u_s / u_u	-3.0	-2.7
Relative Education Price	p_e / u_u	-6.0	-4.6
Stock of Skilled Labour per worker	LS/P	41.3	12.9
Stock of Unskilled Labour per worker	LU/P	-2.6	-1.2
Capital Stock Index (value weights)	K/P	53.1	13.7

Table 5: Vietnam Unilateral Trade Liberalization (% change from base)

	Year 1	Year 5	Year 10	Year 100
Real GDP per capita	2.1	10.2	18.6	40.1
Real Consumption per capita	8.4	-21.4	-14.5	6.3
Invesment in Machinery and Equipment	23.6	31.7	28.4	23.3
Investment in Structures	23.2	30.0	25.6	16.2
Investment in Housing	-21.9	-18.8	-16.2	-15.9
Real return to Machine and Equipment	-0.1	9.1	3.0	-3.3
Real return to Structures	1.1	14.3	9.5	-2.0
Real return to Housing	8.4	-11.2	-4.2	-1.9
Real Skilled wages	23.0	25.7	23.2	9.5
Real Unksilled wages	5.3	-0.3	3.0	12.1
Land rents	-13.7	-13.4	-14.7	-13.3
Resource rent	-16.2	-6.3	-9.7	-13.5
Skill Premium	16.7	26.0	19.6	-2.4
Education Output relative to GDP	20.9	26.3	18.2	0.7
Ls/Lu	0.3	6.9	15.0	44.7
Internal Exchange Rate (pT/pNT)	-7.5	0.7	-3.0	-6.6
Terms of Trade	-12.9	-13.7	-13.5	-13.9
Trade Surplus	-22.0	1.9	1.6	0.0
Openness	10.3	15.3	11.2	5.4

	Year 1	Year 5	Year 10	Year 100
Agriculture	-33.5	-26.8	-29.6	-32.7
Minerals	-6.3	-17.6	-16.1	-9.2
Lowtech	58.7	112.5	113.3	113.6
Intermediate Manufacture	7.1	41.6	56.6	91.5
Durables	-39.5	-8.7	12.0	62.2
Traded_Serives	-5.9	22.2	49.0	113.0
Construction	8.6	18.6	28.7	51.3
Non Traded Services	6.0	28.8	36.4	55.2
Public	-1.1	-9.0	-0.4	25.3
Housing	3.2	-18.4	-14.7	1.1
Education	23.4	39.1	40.1	41.0

Table 6: China Unilateral Trade Liberalization (% change from base)

	Year 1	Year 5	Year 10	Year 100
Real GDP per capita	1.2	3.3	5.4	10.7
Real Consumption per capita	1.3	-2.3	-4.1	1.1
Invesment in Machinery and Equipment	5.0	5.3	5.3	4.7
Investment in Structures	4.7	5.4	5.5	4.3
Investment in Housing	-6.5	-8.5	-8.7	-7.3
Real return to Machine and Equipment	2.6	1.0	-0.3	-2.0
Real return to Structures	1.8	2.7	2.5	-0.2
Real return to Housing	1.8	-0.9	-1.3	-0.2
Real Skilled wages	4.0	7.0	8.9	3.0
Real Unksilled wages	0.4	1.9	3.0	5.3
Land rents	-4.7	-5.3	-5.3	-2.2
Resource rent	-2.1	-1.3	-0.6	1.9
Skill Premium	3.5	5.1	5.7	-2.3
Education Output relative to GDP	4.2	3.8	3.3	2.3
Ls/Lu	0.1	1.6	3.5	14.3
Internal Exchange Rate (pT/pNT)	-1.4	-1.4	-1.5	-0.7
Terms of Trade	-6.6	-5.8	-5.4	-6.0
Trade Surplus	-4.4	-1.6	0.1	0.0
Openness	29.2	29.5	29.4	26.7

	Year 1	Year 5	Year 10	Year 100
Agriculture	-10.1	-11.6	-12.2	-8.6
Minerals	3.5	6.8	10.1	17.6
Lowtech	3.6	7.5	10.6	14.8
Intermediate Manufacture	0.5	4.5	8.1	14.5
Durables	5.9	12.7	18.1	25.0
Traded_Serives	1.7	3.1	5.0	12.1
Construction	3.0	5.0	7.2	12.6
Non Traded Services	1.7	3.2	5.0	10.7
Public	0.4	1.3	2.6	8.9
Housing	0.8	-1.4	-2.8	2.1
Education	5.4	7.2	8.9	13.2

Table 7: Vietnam Unilateral Trade Liberalization with Capital-Skill Complementarity (% change from base)

	Year 1	Year 5	Year 10	Year 100
Real GDP per capita	1.8	10.2	18.5	33.7
Real Consumption per capita	6.4	-21.1	-14.1	3.5
Invesment in Machinery and Equipment	26.3	35.2	29.6	20.4
Investment in Structures	23.5	29.4	23.3	13.4
Investment in Housing	-27.0	-23.2	-18.2	-19.8
Real return to Machine and Equipment	1.1	11.6	3.8	-4.0
Real return to Structures	2.0	16.5	9.8	-2.5
Real return to Housing	8.6	-14.8	-4.9	-2.5
Real Skilled wages	13.9	23.3	18.9	11.7
Real Unksilled wages	5.3	-1.3	3.6	15.4
Land rents	-16.4	-15.3	-18.1	-18.5
Resource rent	-20.4	-5.4	-11.5	-18.6
Skill Premium	8.2	24.9	14.8	-3.2
Education Output relative to GDP	18.8	19.8	9.6	-6.9
Ls/Lu	0.2	5.9	12.1	26.5
Internal Exchange Rate (pT/pNT)	-7.1	2.3	-2.9	-8.4
Terms of Trade	-13.1	-13.9	-13.6	-13.3
Trade Surplus	-20.7	1.9	1.7	0.0
Openness	37.1	50.2	37.4	19.8

	Year 1	Year 5	Year 10	Year 100
Agriculture	-25.6	-18.2	-21.8	-27.2
Minerals	-2.7	-11.9	-11.1	-7.1
Lowtech	55.2	104.9	106.3	105.2
Intermediate Manufacture	5.5	38.0	53.4	77.8
Durables	-39.8	-9.7	9.7	41.3
Traded_Serives	-8.6	17.5	45.8	95.5
Construction	6.7	16.1	26.4	41.1
Non Traded Services	6.2	27.8	35.3	47.1
Public	0.1	-9.0	0.5	19.6
Housing	1.1	-16.8	-14.4	-3.0
Education	21.0	32.0	29.9	24.5

Figure 4: Changes in the Share of Skilled Labour Employment: Vietnam

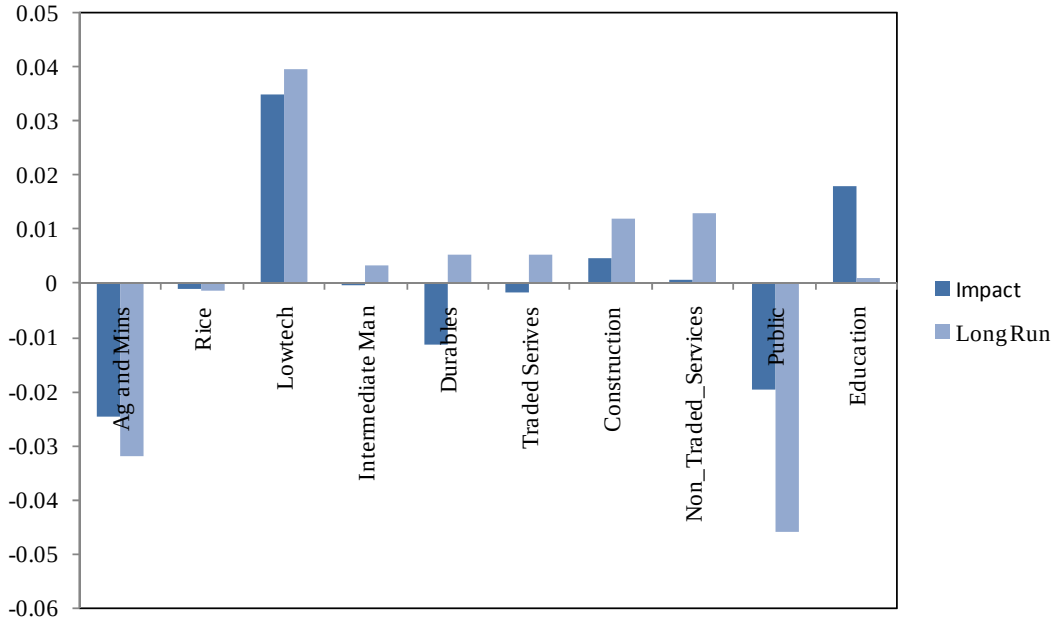
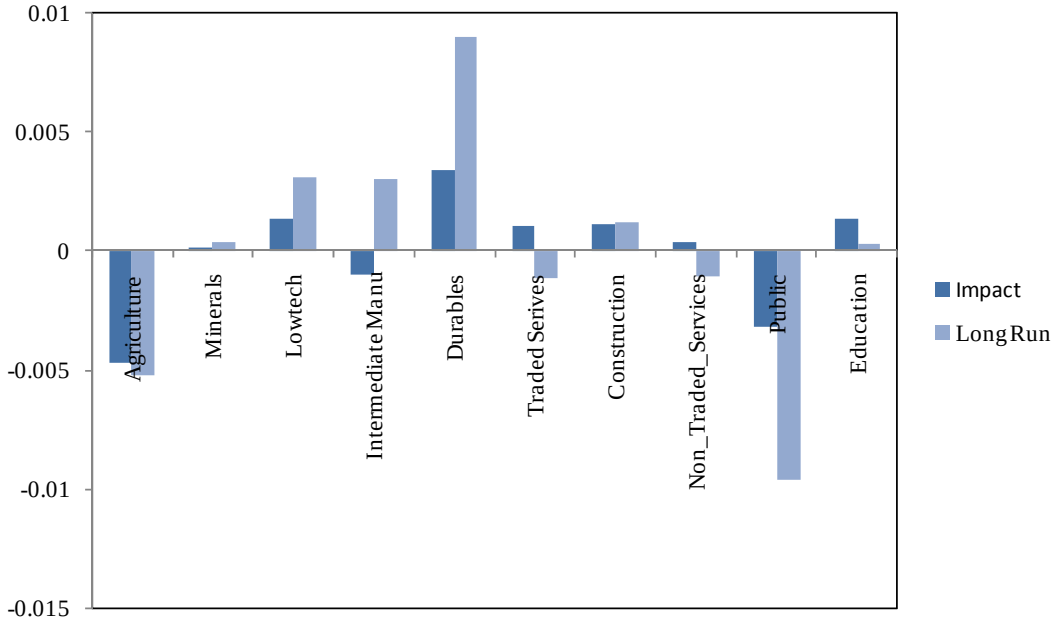
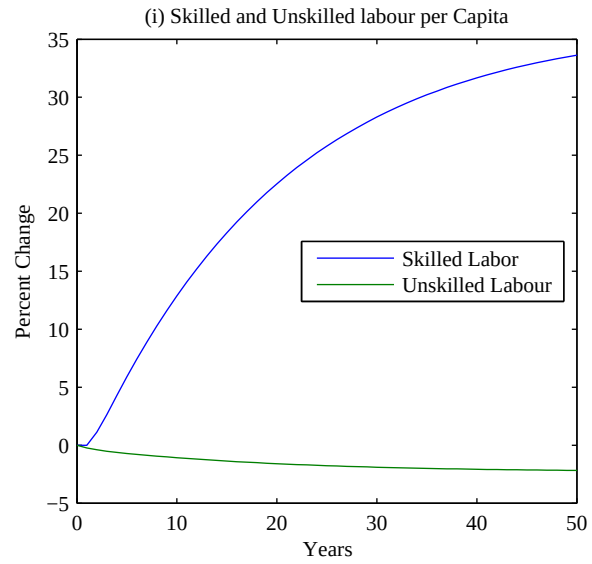
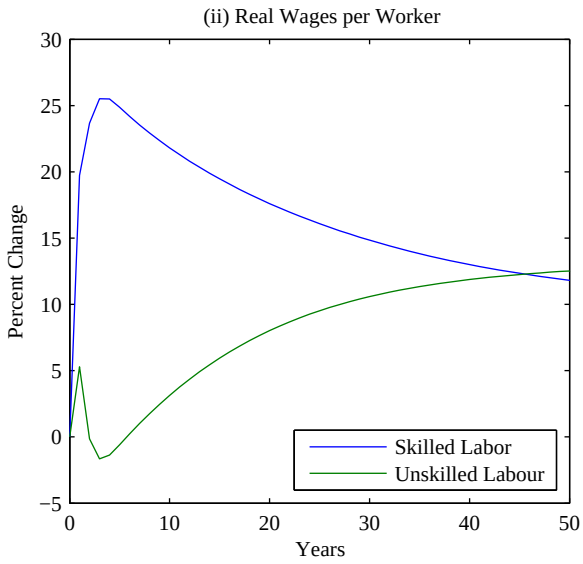


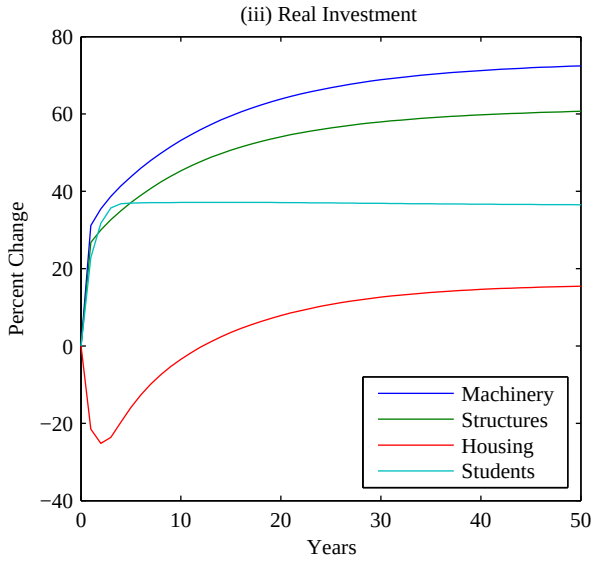
Figure 5: Changes in the Share of Skilled Labour Employment: China

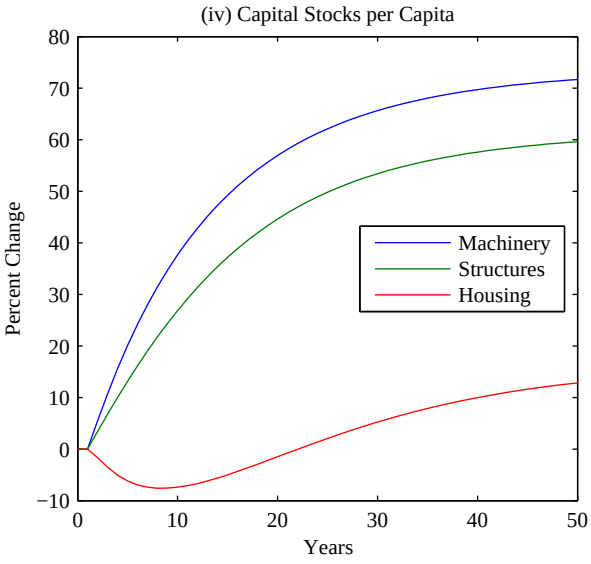


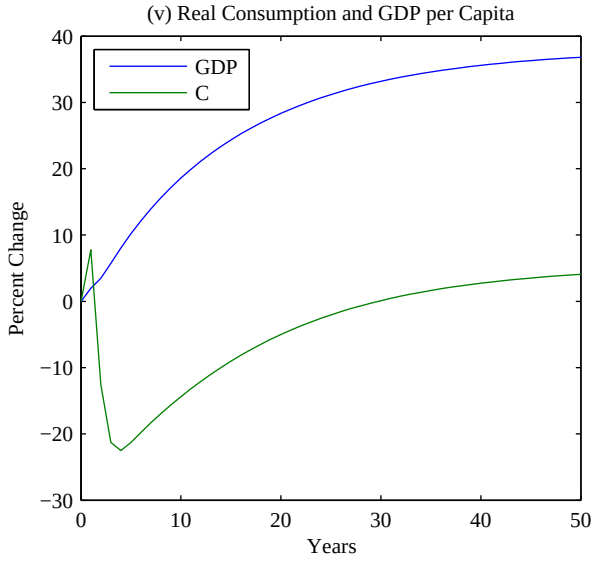
Vietnam: Unilateral Tariff Elimination

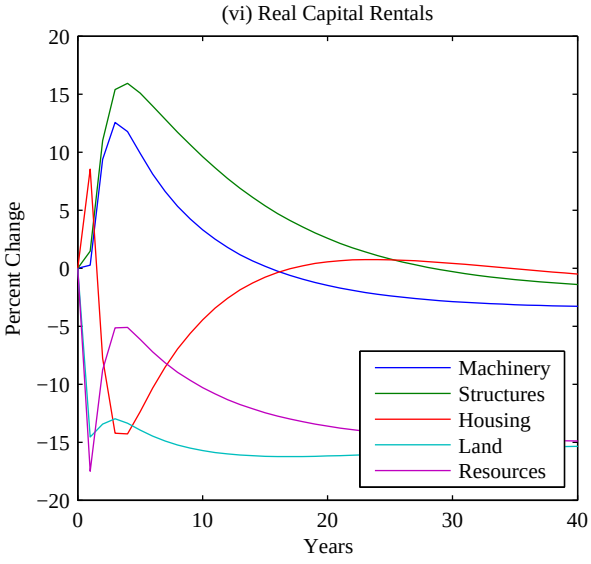












China: Unilateral Tariff Elimination