SPATIAL CONSIDERATIONS IN DISTRIBUTIONAL ANALYSIS:
SOME ANALYTICS AND
POSSIBLE APPLICATIONS TO VIETNAM

A Report on going Work and Outline of Future Research
by Vietnam MIMAP Team

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ABSTRACT

This paper reports ongoing work of the Vietnam MIMAP team on spatial considerations in the analysis of income/welfare distribution issues in Vietnam in the context of globalization/integration and poverty alleviation initiatives in the country, and outlines our plans for further research.

In reporting on ongoing work, we begin with a basic theoretical framework presented in Hamilton and Whalley in 1984 and extended by Whalley and Zhang in 2003-2004 for China and used to analyze the distributional implications of labour mobility restrictions. This is a simple model, with assumption on homogeneity of labour, and has been used to evaluate the impacts of removing migration barriers (eg. the Hukou system in China) on national and regional inequality in terms of GDP per capita, as well as access the overall gain for the economy. Our idea is to further develop this analytical model to take into account fixed transactions costs for rural/urban labour migration and then make calculations for Vietnam which stress spatial considerations in distributional analysis. The problems of both data collection and model treatment (eg. type of experiments, calibration and solving) are discussed in detail. Eventual model results will be used to formulate relevant policy recommendations.

The main section of paper outlines the planned development of the above mentioned core model. These developments focus on the interaction between transactions costs and regional labour and goods mobility/location/distribution, with emphasis on poor people living in remote areas separated from central cities. The plan is to enlarge the basic model structure to incorporate first variable (individual) transactions costs in labour and then variable transactions cost in goods. Some further (and more complicated) elaborations of the model
with variable transactions costs both in labour and in goods are also discussed. These models can also be used to analyze the distributional effects of government poverty policies in such areas as investment policy (in infrastructure such as roads and in health and education), and transfers or subsidies to rural areas. Finally, we briefly outline a further direction for our future research work based on our existing CGE model which seeks to analyze impacts of WTO accession on agriculture and on income/welfare distributions, stressing both inter- and intra-regional inequality in Vietnam.
§1. INTRODUCTION

This paper reports on ongoing work of the Vietnam MIMAP team and outlines main directions for our further research. Our efforts in this piece are concentrated on possible future and new work on spatial considerations in the analysis of income and welfare distributional issues in Vietnam in the context of globalization/integration and poverty alleviation policies in the country.

In recent years Vietnam has accelerated its process of regional and international economic integration. In 1994 the country began to negotiate its accession to WTO. At a regional level, Vietnam joined ASEAN in 1995, APEC in 1998 and has made important commitments in 2006 in the frame-work of AFTA (Tu, 2004). It is known that challenges of integration are closely related to how the country treats mobility of goods (services) and of factors, in particular of capital and labour. Moreover, this liberalization should be effective at the same time both at the border and inside the country, because integration would be impossible without domestic reform, although the former could reinforce the latter. In this context, our previous research (Chan and Dung, 2002) has been devoted to building a CGE model to evaluate impacts of trade liberalization (tariff reduction) on economic efficiency and income distribution among households. Ghosh and Whalley (2003) go further to explore the role of transaction costs for moving goods across geographic regions, especially to the mountainous and remote areas.

Even though one can find much literature on trade liberalization, i.e. toward free movement of goods and services, or of movement of capital, relatively few studies exist of labour migration across countries or regions. As shown in Hamilton and Whalley (1984), even small changes in existing global immigration restrictions can lead to striking annual worldwide efficiency gains. From this same starting point, but at a national level, Whalley and Zhang (2003) consider the role of the system of Hukou, or registered permanent residence, on inequality in China. The findings of this work point out to significant impacts of the Hukou system on overall inequality in China, and significant efficiency gains from its removal. Dealing with labour mobility, our first results were reported in Chan et al. (2003) where we use different labour market treatments in the analysis of the effects of trade liberalization in Vietnam. These results indicate that the redistributive impacts of trade liberalization are sharper against
poor rural households with segmented labour markets and with transactions costs, while aggregate efficiency gains are similar.

In Vietnam, like in other developing countries, it is important, particularly for poverty issues, to also study the movement of labour between rural and urban areas. Thus, the model based counterfactual analyses reported in Whalley and Zhang (2003) show that the Hukou system operates as a barrier to rural/urban migration in China and significantly affects the income distribution. For Vietnam this is also true, but today to find a job in and therefore migrate to city it is not necessary to have registered permanent residence (the inverse is rather true: to get registered permanent residence in the urban areas, it is necessary to have a long-term labour contract). Another observation is that generally only skilled labour\(^1\) can move permanently from rural to urban. Thus skill and education are the main restrictions/barriers to rural/urban migration in Vietnam.

The main objective of this paper is to develop the basic theoretical framework elaborated by Hamilton and Whalley (1984) and extended by Whalley and Zhang (2003), to take into account transactions costs for both rural/urban labour migration and goods shipment and then make calculations for Vietnam. This introduces spatial considerations directly into distributional analysis where they have been largely absent in prior work. Problems of data collection and the treatment and use of models (type of experiments, calibration, and solving) are discussed in detail, as well as how models results will be interpreted in order to formulate relevant policy recommendations.

The developments / elaborations on the core model represent new initiatives for modeling regional labour and good mobility/location/distribution, with emphasis on poor people living in remote areas separated from central cities. The basic Whalley/Zhang model structure has been enlarged to also incorporate first variable (individual) transactions costs in labour and then variable transactions costs in goods. Some further elaborations of the model with variable transactions costs both in labour and in goods are also discussed. For the transactions costs of goods, particularly regarding the remote mountainous regions, some preliminary

\(^1\) By skilled labour we mean employees with at least college/professional or university education. For several years in some central cities, essentially in the capital Hanoi in the North and Ho Chi Minh City in the South, one
results have been obtained by Ghosh and Whalley (2003)\textsuperscript{2}. Finally, we briefly discuss another direction of our research work based on our earlier CGE model work to analyze the distributional impacts of WTO accession in agriculture, with a stress on both inter- and intra-regional inequality in Vietnam. This discussion is also relevant when assessing the effectiveness of government poverty policies in terms of investment (in roads, infrastructure, education and health care in particular), and transfer or subsidies to rural areas.

can observe groups of people coming seasonally from the neighbouring country side to search for occasional jobs. However, this is temporary and there are no statistics available on this component of rural unskilled labour.\textsuperscript{2} See \textit{The Economist} (2002-2003) for a story in Cameroon.
§2. MODELS

We start with an outline of the core model structure and discuss its implementation for a base case for Vietnam. Our model description follows Whalley and Zhang (2003), but now with the introduction of fixed transactions costs for labour mobility and resulting modifications. We then consider appropriate developments of the core model to incorporate first variable transactions costs in labour, and then variable transactions costs in goods.

§ 2.1. The core model structure

Consider an economy with two regions $s$, where $s = U$ (rural) or $R$ (rural). Each region produces a single good $Y$ according to a region specific Cobb-Douglas production function. There are two factors of production – capital and labour. Capital (mainly land in agriculture) is assumed to be fixed everywhere in the model experiments. Labour is homogenous in the basic case and can move from rural to urban with some transactions costs. A decreasing returns to scale production function for regions can be written as

$$ Y_s = A_s L_s^{\alpha_s}, \quad s = U, R \quad (1) $$

where $L_s$ stands for labour in region $s$; $A_s$ is the scale parameter; and $\alpha_s$ is the share parameter, $0 < \alpha_s < 1$.

The regional wage $W_s$ is equal to the marginal value of product of labour:

$$ W_s = \frac{\partial Y_s}{\partial L_s} = \alpha_s A_s L_s^{\alpha_s - 1}, \quad s = U, R \quad (2) $$

and regional rents (returns to regional specific fixed factors) are

$$ R_s = Y_s - W_s L_s, \quad s = U, R \quad (3) $$

Note that because of rents, even in the case of full mobility of labour where $W_U = W_R$, GDP per capita will not be equal across regions.

Setting the unit price of the single good equal to 1 as a units convention, we have income $I_s$ in region $s$:

$$ I_s = Y_s, \quad s = U, R \quad (4) $$
and
\[
\sum L_s = L
\]  
(5)

where \(L\) is the total endowment of labour.

If there are restrictions on labour mobility, wages will be not equal across regions (normally \(W_U > W_R\)). Assume that labour can move from rural to urban at a constant proportional transaction cost \(t\), evaluated as a percentage of the rural labour wage. If there no further barriers to labour mobility

\[
W_U = (1 + t)W_R
\]  
(6)

Denote \(\Delta L_R\) as the rural labour which moves

\[
\Delta L_R = L_R^0 - L_R
\]  
(7)

where superscript \(^0\) indicates the benchmark data (for example, \(L_R^0\) is the benchmark rural labour).

Then total transactions costs are

\[
T = (W_U - W_R) \Delta L_R
\]  
(8)

We assume that transactions (moving labour) use real resources and the latter are denominated in terms of labour. Thus, if the transactions costs are borne by rural labour when they move, then the labour destroyed in transactions costs (the labour neither used in urban sector nor in rural sector) will be

\[
L_T = \frac{T}{W_U}
\]  
(9)

In place of (5) we thus now have the new labour market equilibrium condition
(1) – (4) remain in force and the overall gain for the economy

\[ Z = Y - Y^0 \]  

Note that transactions costs have been already incorporated in the resources available for production (10), so are not explicitly required in the income statement.

In particular, for the wage income:

For rural labour:

\[ I^w_R = W_R L_R \]  

For urban labour (see (7) – (9)):

\[
I^w_U = W_U L_U = W_U (\bar{L} - L_R - T^T) = W_U (L^0_U + L^0_R - L_R - L_T) \\
= W_U (L^0_U + \Delta L_R - L_T) = W_U L^0_U + W_U \Delta L_R - T \\
= W_U L^0_U + W_R \Delta L_R
\]  

In the right hand side of (13) the first term gives the wage income of the urban labour (who stay always in urban areas) while the second term corresponds to the wage income after transactions costs of the rural labour moved to the urban area. The \( \Delta L_R \) of labour who move now benefit from a higher wage \( W_U \), but have to pay transactions costs \( T \).

If initial values \( L^0_s \) and parameters \( \alpha_s \) (\( s = U, R \)) are determined by calibration to a base case data set, the relations (2), (6), (9) (with (7) and (8) and (10) form a system of 4 equations for 4 unknowns \( W_U, W_R, L_U \) and \( L_R \). Solving this system, we can find values for all these variables and then calculate \( R_s, Y_s(I_s), T \) for the counterfactual case where we remove labour mobility restrictions, and then determine the overall gain for the economy from a removal of restrictions on labour mobility.

In order to evaluate impacts in terms of GDP per capita, as in Whalley and Zhang (2004), we need to consider the population as well as the labour force. Denoting by \( N_s \) the population in
region s, s = U, R and by N the total national population, \( N = \sum_s N_s \), the average income \( \bar{I}_s \) in region s is

\[
\bar{I}_s = \frac{I_s}{N_s}, \quad s = U, R
\]  

(14)

Given the national income \( I = \sum_s I_s \), the average national income is

\[
\bar{I} = \frac{I}{N} = \frac{\sum_s I_s}{\sum_s N_s}
\]  

(15)

The average wage per individual in region s is

\[
\bar{W}_s = \frac{W_s L_s}{N_s}, \quad s = U, R
\]  

(16)

We assume that the labour force is homogenously distributed across the population, so if \( \lambda \) stands for quantity of labour units embodied in each individual, we have in the benchmark equilibrium

\[
\lambda^0 = \frac{\bar{I}}{N} = \frac{I_u^0 + I_r^0}{N}
\]  

(17)

\[
N_s^0 = \frac{1}{\lambda^0} I_s^0, \quad s = U, R
\]  

(18)

and in the counterfactual (the total population N being fixed)

\[
\lambda = \frac{I_u + I_r}{N}
\]  

(19)
\[ N_s = \frac{1}{\lambda} L_s \quad s = U, R \]  
(20)

(note that \( L_U + L_R = L - L_T < L \) due to the labour resource \( L_T \) lost in transacting)

We can thus determine the GDP per capita for each region and for all the country either with or without a labour market restriction, in the presence of transactions costs. Although we only consider the 2 region case here we can also consider a single urban region and multiple rural regions. This allows us to generate a spatial distribution of wage rates and incomes, and analyze the income distribution impacts of such initiatives as trade liberalization or infrastructure initiative (new roads) in this framework.

Similarly to Whalley and Zhang (2004), the model set out in this section can be developed to also incorporate labour efficiency differences across individuals and hence to capture within region inequality in terms of Gini coefficients.
§2.2. Model with variable transaction costs in labour

In the model in section §2.1, the transactions costs rate for labour moving from rural to urban are constant, i.e. the same for all the people who move. In reality, transactions costs can vary from an individual to another. For example, it can be higher for a person with low skill than for a person with average skill, lower for young people than for old people, higher for the people from farther location from the central city than for the people from nearer location and so on. Thus it is important to also consider variable (individual) transactions costs.

Denoting by \( m \) the index of people who move from rural to urban, \( m = 1, 2, \ldots, M \) (\( M \) is the last individual to move), and assuming that transactions costs rate \( t_m \) for individual \( m \) is determined by the following formula:

\[
 t_m = \gamma m^\alpha, \quad m = 1, 2, \ldots, M
\]  

(21)

where \( \gamma \) and \( \alpha \) are parameters. Then

\[
 W_U = (1+t_M)W_R
\]  

(22)

In this case the total transactions costs for people who move equals

\[
 T = \sum_{m=1}^{M} t_m W_R = \gamma W_R \sum_{m=1}^{M} m^\alpha
\]  

(23)

Analogous to the case of fixed transactions costs, the resource loss denoted in terms of labour will be

\[
 L_T = \frac{T}{W_U}
\]  

(24)

The labour market equilibrium condition is now

\[
 L_R = L_R^0 - M
\]  

(25)

\[
 L = L_R + L_U + L_T
\]  

(26)

Income from wages for urban labour can be determined as follows:
The interpretation of the terms in the right hand side of (27) is similar to (13). In a counterfactual case, given the values of $L^0_i$ and the parameters $\alpha_i, A_s$ determined by calibration $s= U, R$. Substituting $L_U$ from (26), $L_R$ from (25), $L_T$ from (24), $T$ from (23) and $W_s, s= U, R$ from (2) into (22), gives one equation in one unknown $M$. We can thus find value of $M$ which equals either the solution of this equation if the solution is an integer or the integer nearest the solution if this latter is not an integer, and then calculate $W_U, W_R, t_M, L_R$ and $L_U$.

The determination of regional and national GDP per capita is similar to the model with fixed transactions costs.

In this model, transactions costs for the marginal person who moves are endogenously determined, and the impact on the spatial distribution of wage rates will be different than the fixed transactions costs case. This model can similarly be applied to analyze the distributional impacts of trade liberalization or infrastructure initiatives (roads, education, health care).
§2.3. A Model with variable transaction costs in goods

We can also extend the basic model set out in §2.1 to take into account different transaction costs of shipping goods from increasingly remote rural locations to a central city. For now we assume all such trade in goods is unidirectional (from the rural regions to the city) rather than 2 way, but 2 way trade can be incorporated in subsequent extensions. We note in passing that a simple model with constant transactions costs for goods between a central city and remote areas has been presented in Ghosh and Whalley (2003). This model also can be used to analyze the spatial distribution of both the burden and gains by group from trade liberalization as well as the implications of regional infrastructure projects and anti-poverty transfer programmes.

Consider an economy with one urban region U and J rural regions $R_j, j=1,2,...,J$. We assume all the regions produce the same good $Y$ each with a decreasing returns production function of the form

$$Y_U = A U L_U^\alpha$$

(28)

$$Y_j = A_j L_j^\alpha$$  \hspace{1cm} j = 1, 2, ..., J

We assume that the trade flows go only from rural regions to urban, and for now there are no transactions costs in moving labour between locations. If $p$ stands for the price of the good in the urban region, then the price received by seller in rural region $j$ is given by as

$$p_j = (p - \beta_j^\nu)$$ \hspace{1cm} j = 1, 2, ..., J

(29)

where $\beta_j^\nu$ represent the cost of transport of one unit of product from region $j$ to the city, $\beta$ and $\nu$ are parameters. Here, the geographical distance between the central region and rural region, increases together with the index $j$. Thus, if $W_U$ and $W_j$ denote the wage rate respectively in the city and in region $j$ we have the following equations:

$$p W_U = (p - \beta_j^\nu) W_j \hspace{1cm} j = 1, 2, ..., J$$

(30)

$$W_U = \alpha U A U L_U^\nu$$

(31)
\[ W_j = \alpha_j A_j L_j^* \quad j = 1, 2, \ldots, J \]  

(32)

\[ L_U + \sum_{j} L_j = \overline{L} \]  

(33)

These \((2J + 2)\) equations together with a standard normalization condition on prices and wages

\[ p + W_U + \sum_{j} W_j = 1 \]  

(34)

(or \(p=1\)) yield a system of \((2J + 3)\) equations for \((2J+3)\) unknowns \(p, W_U, L_U, W_j, L_j, j \in J\). Solving this system gives us a solution of the model which implies a region specific wage, and a wage distribution reflecting in the case, the cost of shipping goods from rural regions to the central city.

The limited empirical evident that exists (see the discussion of the situation in the Cameroon in the Economist, July 2002) indicates that shipment costs by location to central cities can be extremely large in poorer countries. The impacts of road construction on distribution are also discussed theoretically in a related framework by Jacoby (2000).

This formulation can be important for changing thinking on the key determinants of inequality in poorer countries by stressing spatial considerations. It can also be combined with the labour markets/transactions costs formulation above to yield a combined formulation capturing goods/labour market transactions costs and wage inequality.
§3. Models implementation and data calibration

We have implemented the base (no transactions costs) model and the first labour mobility/fixed transactions costs model for the Vietnam economy and estimated the impacts of removing existing barriers to labour mobility. We use the latest data from I/O Table 2000 (GSO, 2001), the Vietnam Living Standards Survey (VLSS 2002) (GSO, 2003) and some other sources (CIEM 2003, MOLISA 2002).

This is shown in Table 1, which sets out the urban and rural wage rates and the distribution of population by region. The base case is assumed to have labour migration restrictions in place, and our counterfactual experiment is to remove them. Below we present our calculations for the core model with fixed transactions costs for moving labour from rural to urban (see §2.1). The results of implementing other models with variable transactions costs in labour (see §2.2) or in goods (see §2.3) will be reported on later.

To calibrate the model, we take values of $Y_{0s}$, $L_{0s}$ and $W_{0s}$, $s=U,R$ from the benchmark data. Solving the calibration system we find these parameters for the model (Table 1).

Table 2 presents simulations results from the model for four different rates of transactions costs: $t=0$, 10%, 15%, and 20%. One can observe that inequality in terms of GDP per capita is considerably improved even in the case of 20% transactions costs: the ratio of GDP per capita urban/rural falls from 4.4 in the benchmark to 1.2, 1.15, 1.1 and to almost 1.0 in the case of 20%, 15%, 10% and 0% transactions costs respectively. We have the same positive impact with income per worker. At a national level, the overall efficiency gain (denoted in terms of percentage increase in GDP) is also significant and varies from 0.26 in no transactions costs case to 0.20 in 20% transactions costs case. The average national income increases by at least 20% in the 20% transactions costs case (by 26% in no transactions costs case).

The removal of restrictions on labour mobility, whether with or without transactions costs, yields strong improvements in GDP per capita but these improvements do not vary that much when the transactions costs change.
Table 1: Data used to calibrate the model with fixed transactions costs in labour

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (1000 bill. VND)</td>
<td>536.098</td>
<td>319.4816</td>
<td>216.6164</td>
</tr>
<tr>
<td>Population (mill. pers.)</td>
<td>79.7270</td>
<td>20.0220</td>
<td>59.7050</td>
</tr>
<tr>
<td>Wage rate</td>
<td>6.1443</td>
<td>15.6445</td>
<td>3.2413</td>
</tr>
<tr>
<td>GDP/capita (mill. VND)</td>
<td>6.124</td>
<td>15.9565</td>
<td>3.6281</td>
</tr>
<tr>
<td>Income/worker (mill. VND)</td>
<td>13.6448</td>
<td>34.7432</td>
<td>7.1980</td>
</tr>
<tr>
<td>Average national income (mill. VND)</td>
<td>6.7242</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Parameters:  

\[ A_U = 117.6408 \quad A_R = 46.7648 \]
\[ \alpha_U = 0.450289 \quad \alpha_R = 0.450308 \]
Table 2: Simulations results of the model from removing labour mobility restrictions with fixed transactions costs in labour

<table>
<thead>
<tr>
<th></th>
<th>t=0</th>
<th>t=0.10</th>
<th>t=0.15</th>
<th>t=0.20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>%change GDP</td>
<td>0.78</td>
<td>-0.51</td>
<td>0.71</td>
<td>-0.49</td>
</tr>
<tr>
<td>% change in Labor force</td>
<td>2.60</td>
<td>-0.79</td>
<td>2.31</td>
<td>-0.77</td>
</tr>
<tr>
<td>% change in Population</td>
<td>2.36</td>
<td>-0.79</td>
<td>2.26</td>
<td>-0.76</td>
</tr>
<tr>
<td>Wage rate</td>
<td>7.7363</td>
<td></td>
<td>8.1058</td>
<td></td>
</tr>
<tr>
<td>GDP/capita (mill. VND)</td>
<td>8.4667</td>
<td>8.4664</td>
<td>8.3920</td>
<td>7.6288</td>
</tr>
<tr>
<td>Overall gain (%)</td>
<td>0.26</td>
<td></td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>Average national income (mill. VND)</td>
<td>8.4666</td>
<td></td>
<td>8.2533</td>
<td></td>
</tr>
</tbody>
</table>
§4. Some possible further extensions of the models

The models presented in section §2 and the following subsections can be further developed and elaborated on. One will be to include multiple regions in the rural area rather than just one region. In the case of Vietnam, most data are available for 8 economic regions. A second development is to combine both transactions costs in labour and in goods in one model which will be more complicated but still tractable. A third will be to take into consideration inter-regional and/or international trade flows instead of only flows from rural to urban as in the model in §2.3.

Also, for the above analysis migration is considered only as an individual decision. In reality, however, it is often a family decision – the person who moves to the city to find a job has often to send back a part of his earnings (remittances) to his family who always stay in the village. Other family members then subsequently migrate and join the initial migrant in the city. Studying this phenomenon requires modification of the earlier models.

All the models discussed in this paper will be used to explore the inequality implications of the removal of restrictions on labour mobility and spatial redistributional policy changes. A further direction of research relevant to Vietnam is to also focus on inequality within regions, and in particular intra-rural inequality under impacts of the country’s regional and international economic integration.

Thus, it is commonly expected that under accession to the WTO Vietnam will eliminate production subsidies for agriculture and export subsidies for agri-products. If the price of agricultural products is taken as set on world markets, the domestic price will fall as subsidies go. It is thus believed that this integration process will be anti-poor and the rural areas will suffer. Our earlier modelling results presented in Chan and Dung (2002) show, for example, that trade liberalization (tariff reduction) worse affects the poor and rural people.

However, in Vietnam, farmers work in both agriculture and non-agriculture (manufacturing/service). Many of them run small township/village enterprise (TVE). Under WTO accession, wealthy farmers can devote more time and resources to TVE while poor farmers cannot. Consequently, an important redistributional effect can occur within rural areas and may be this intra-redistributional effect in agricultural sector could be more important than between
rural and urban sectors. A general equilibrium approach capturing this feature and building on the model in Chan and Dung (2002) can provide valuable insights on these important for Vietnam issues. Our idea here is therefore to modify existing CGE models Chan and Dung (2002) to investigate this phenomenon.
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