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The need for a „complete“ labor market in CGE modeling

- Abstract –

Marianne Kurzweil

Unemployment in the whole world is at an all-time high. But nowhere is the employment challenge greater than in the developing world, particularly in Africa. Former studies already suggested that in order to reduce poverty you have to take care of a country’s employment situation. Even though, when it comes to development policy and analysis, research mostly concentrates on trade and investment issues. In the case of CGE (Computable General Equilibrium) modeling the focus mostly lies on the welfare and GDP effects of a trade policy change; i.e. no variable is explicitly concerned with labor or employment issues. No wonder, since those issues are highly under represented in the existing general equilibrium models.

First of all this paper points out the importance of labor market issues in development policies. Particularly in the course of globalization trade and liberalization of export oriented policies are taken into consideration, but generally the focus lies on those labor market policies which are applied in the developing world at most. Secondly, the paper provides a review of various approaches of labor market modeling and introduces some starting points of integrating the labor market and corresponding policies, like minimum wages, in the CGE model GTAP (Global Trade Analysis Project). Finally, some specific simulations are carried out with the extended but also with the standard model, in order to compare the results and elucidate the influence of the new implemented components.

Keywords: development policy; labor markets; employment; GTAP

1. Introduction

1.1 Problem Statement and Motivation of this Paper

One of the central global challenges at the start of the 21st century is the fight against poverty, and thus improve and secure a life in condition of human dignity for the 1.2 billion people still living below the poverty line. Already in 1995, the World Summit for Social Development claimed employment as fundamental pillar of international strategies to increase opportunities for those people to achieve sustainable livelihoods and maintain a fair and acceptable standard of living. Furthermore, in the course of continuing globalization another major principle and governmental challenge is to promote and ensure the rights at work with the objective to make globalization work for all.

Sustainability is one of the keywords of this conference but also an important issue with respect to development policy. As pointed out above, sustainable development and labor market issues are closely related topics. In particular policy instruments concerning labor market and employment experience an increased attention when it comes to economic aid to developing countries or poverty alleviation in general. The basic objective of such policies is to provide income security combined with institutional assistance in improving employability and job placement of those out of work or threatened by unemployment.

Of course the implementation of labor market policies has more or less strong impacts on various factors in the economy of a country. Those impacts range from changes in the labor market itself to changes in a country's GDP or welfare level whereas the overall impact can be positive as

well as negative. In the process of globalization with its on-going trade liberalization and cross-border exchange of resources, the significance of the labor market policies can vary, because this process influences a country's overall employment situation or unemployment threats in specific sectors etc.

This is the reason why CGE Models play an increasingly important role in policy design. Those models represent a useful tool to provide an ex-ante analysis of economic impacts of policy changes before and after a trade liberalization in one or several specific sectors or industries. But although it is commonly known and accepted that employment issues are fundamental in development economics, researchers have only started to deal with the modelling of labor markets and coresponding policies. Most modeling approaches, however, do not take employment issues into account at all. Of course this makes it difficult to picture the effect on employment in a realistic and reliable way. In short: the aspects which represent the basic indicators showing if a policy set is suitable to ensure sustainable development or not, are not sufficiently depicted in the existing models.

With this background the objective of this paper is to emphasize the importance of employment issues in development politics and thus in CGE analysis with regard to the additional challenges arising through globalization.

1.2 Structure of the Paper

In order to provide the reader with the basic information the second chapter describes how the labor markets in developing countries generally look like. First of all the relations between development, employment and trade are explained. The section draws out that those three issues are interdependent and at the same time emphasizes the importance of labor issues concerning the aspect of sustainability in development politics. In the second part of this chapter the focus lies on the employment situation, particularly on the status of unemployment, and furthermore on how the labor market is organized and which policies are most frequently used. The third chapter represents a survey about the existing literature and modeling approaches of the labor market in the CGE field. This survey comprises the basic features as well as extensions in terms of additional labor market details and specific policies. Referring to these modeling extensions the following fourth chapter contains the empirical part of the paper. Within the framework of the comparative-static standard multi-regional GTAP model new features are implemented in the model’s labor market. With this revised version various simulation scenarios are carried out and finally, in chapter 5 the results achieved are interpreted. Here the focus lies on the impacts of labor market extensions on simulation results.

2. Empirical Background

2.1 Interdependencies: Employment – Trade - Development

For most households, poor and prosperous alike, income from work is the main determinant of their living conditions. Without a regular income a family is not able to come up with its basic needs, like food, health, housing etc.. Thus one of the most important steps in regional development is an improvement of the employment situation of the population. Therefore, a rising labor demand is necessary to guide the process of development and ensure sustained growth. Trade has the potential to create employment as well as to improve the welfare of workers. Economic integration is creating a global labor market where wage and employment decisions in one country are increasingly influenced by interaction with other countries. Trading goods or services with other countries can stimulate production through increased exports and thus at the same time increase the demand for workers and diminish unemployment. Nevertheless a pre-condition for achieving those

gains from trade is a sound domestic policy. On the one hand a policy regime is needed that keeps up with improvements in their competitors' productivity. And on the other hand labor market policies should enable a country to make best use of its working-age population in order to sustain the growth these countries need.

2.2 Labor Markets in Developing Countries[1]

The majority of the 2.5 billion workers of the labor force of developing countries belongs to the category of low- or lower-middle-income workers. Those groups are specified by GNI per capita with the low-income group earning $755 or less and the lower-middle income workers receiving between $756 - $2,995. There are vast differences in the patterns of employment across those two categories. In poor countries a large share of the labor force works in agriculture, mainly tending family farms, while another part works in the rural non-farm and urban informal sector. Only a very meager share of those workers have wage contracts, usually in urban industrial and service employment. In middle-income countries less workers are employed in the agricultural sector whereas there are more workers in a wage employment in industry and services. Workers in low-income countries dominate the world's agricultural work force but also supply nearly half of the entire industrial workers. Furthermore, low-income countries account for approximately one third of the world's unemployment rate.

In many developing countries workers lack representation and work in unhealthy, dangerous or demeaning conditions. Although 90% of developing countries have some form of social security system, at best it covers workers only in the formal sector, who make up just for 15% of the labor force in low-income and 45% in middle-income countries. The workers employed in the informal sector are not affected by labor market policies and therefore often earn less than half of what a formal employee receives. In Sub-Saharan Africa as well as in South Asia attempts to maintain the formal workers' privileged position are often based on institutional interventions, like featherbedding of the public sector, rather than on raising labor demand or improving productivity. But wage inequalities not only exist between the formal and informal labor markets , but also across different ethnic groups, men and women and indeed households. Nearly all governments set work-place standards such as minimum wages or protections for minority groups. But due to a lack of administrative capacity, standards and labor market regulations are often not enforced even in many firms that are normally considered part of the modern sector.

Basically there are three routes by which governments intervene in the labor market: policies that introduce a pro-industry, anti-agriculture bias; policies that are biased against labor demand within agriculture; and regulations designed to make formal sector employment more attractive to workers. Unfortunately, these kinds of policies tend to slow down, not to speed, the shift toward a more productive and more formalized economy.

3. The Labor Market in CGE Modeling

This chapter provides a brief overview about several existing modeling approaches of the labor market in a general equilibrium framework. In the first part the basic issues used for labor market construction in CGE models are described. The following part of this chapter presents a more detailed labor market version by showing various modeling approaches including further extensions of the labor market itself. Finally, the approaches explained in the last section introduce governmental interventions; i.e. there are employment specific policy instruments implemented in the basic modeling framework. The intention of this chapter is to represent a brief survey about the

[1] All data in this section were obtained from the WORLD DEVELOPMENT REPORT, The World Bank 1995.

literature and the main streams in this research area. No attempt has been made to reach complete coverage.

3.1 General Characteristics

The labor market represents one part of the macroeconomic components in a CGE model. Among other primary factors labor is assumed to be an input in a neoclassical production function, like a Cobb-Douglas, a CES or a LEONTIEF function. Usually labor supply is fixed exogenously[2], and according to the profit-maximizing behavior of the productive sector labor demand is determined. Since the fundamental property of a neoclassical general equilibrium model is the concept of a flow equilibrium in product and factor markets, labor demand is derived endogenously as a function of output price and wage, and is equalized to labor supply. This is a fundamental requirement for market clearing. In the labor market the variable responsible for equilibrating is the average wage rate which varies in order to achieve an economy-wide full employment equilibrium. In the model closure the equilibrium situation is defined by an additional excess demand equation representing a system constraint. Due to this constraint the model has to satisfy an accounting identity for the labor market as well as for other factor markets and also product markets. Based on these equations the sum of excess demands across all markets has to be zero; i.e. Walras' Law is satisfied. In the case of the factor markets the accounting identity states that factor payments equal total sales. In most CGE models the labor demand equation specifies the demand by sector whereas usually perfect inter-sectoral labor mobility is assumed.

Moreover, concerning developing countries, modelers soon started to extend this neoclassical approach because of limited substitution possibilities and other market imperfections. With their extensions they tried to capture specific structuralist features of the developing countries' economies. ROBINSON (1989) distinguishes in his paper three categories of structuralist CGE models.

3.2 Labor Market Extensions

3.2.1 Dualistic Labor Market

In the second chapter the relevance of a dual labor market in developing countries was exposed. Obviously, it would be very helpful to model this feature because one can imagine that such a division of the labor market has noticeable effects on wages, welfare and the impacts of policies. FIESS et al. (2002) implement such a dual labor market in their model whereas workers in the informal sector are treated as self-employed. Thus, while workers in the formal sector are salaried equally, the informal workers' wages differ in terms of entrepreneurial capability represented by an extra parameter. Workers are assumed to be indifferent between the salaried work and the self-employment, but a spill-over from one sector to the other is always accompanied by additional costs. Moreover, the formal sector is supposed to produce tradable and the informal sector non-tradable goods. According to these assumptions listed above production, consumption and firm behavior is adapted and therefore differ among both labor markets.

A similar approach can be found in DECALUWÉ et al. (2000). In their model a dual labor market is also included whereas here differing wages due to entrepreneurial capability in the informal sector are not taken into account. Instead, there the average wage in the informal sector is derived from an endogenous labor supply with workers being not self-employed. Since total labor supply is supposed to be fix and workers prefer to be employed in the formal sector, this informal labor supply depends on the labor surplus in the formal sector; i.e. rationed formal workers move to

[2] There exist approaches assuming labor supply as endogenous, but those are not taken into account in this paper.

the informal sector to compete for employment. Further differences to the former approach are that there are neither spill-over costs nor a distinction between tradable and non-tradable goods implemented.

3.2.2 Labor Categories

One of the most frequently used kind of extensions of the labor market in a CGE model framework is to split-up the whole labor force in specific labor categories. Basically there exist two forms of specification. First, labor can be disaggregated by skill category or educational level respectively, like skilled and unskilled labor. In LÖFGREN (2001) the labor market is disaggregated into even four different skill categories which are: no, low, medium and high educational level. The second possibility is to segment the labor market across several sectors, e.g. agriculture, manufactures etc., which may result in differing wages among sectors. The segmentation over such broad categories can also comprise a split-up in urban and rural labor force.

Moreover, such specifications of the labor market allow for further modifications of the model. For example, on the one hand there exist approaches assuming significant and persistent wage differentials across sectors for the same occupational group (see KATZ and SUMMERS (1989)). On the other hand quoting MAECHLER and ROLAND-HOLST (1998), labor of a specific skill is considered perfectly mobile across sectors implying a single economy-wide average wage for each skill. In combination with the formal/informal approach explained above even more modifications are possible. CARNEIRO and ARBACHE (2002) use a division including a combination of education level, urban/rural split-up and of a dual labor market. In their model it finally comes down to 8 different labor categories.

In all these cases labor is modeled as a CES (Constant Elasticity of Substitution) aggregate of the defined labor categories. Of course the value of substitutability between the different labor categories depends on the types and number of the specific categories and on the remaining part of the underlying production technology.

Obviously, these extensions provide a more detailed picture of a labor market and therefore allow for further conclusions when it comes to analyze the impacts of some specific economic changes on the employment situation of a country.

3.2.3 Wage Differential

3.2.3.1 Exogenous Wage Differential

This kind of labor market extension assumes a wage differential among sectors, which can be determined exogenously. In their model THIERFELDER and SHIELLS (1997) identify the factor payment differentials as model variables e.g. $WD_{i,f}$, where ‘i’ refers to the sector and ‘f’ refers to the factor. With respect to the factor ‘labor’ the value of $WD_{i,f}$ indicates the deviation of a certain sector specific wage from the economy-wide average wage. Of course the wage level in this specific sector can either lie below or above the average wage. Since the wage differentials are exogenous they influence the producers’ demand for workers, but resource allocation itself is determined endogenously by the change in the economy-wide average wage.

The model becomes even more detailed, when more labor categories are assumed to split up the entire work force. In this case JONES (1971) states that in such an extended labor market the wage differentials by labor type will be smaller than in a model with e.g. just a skilled/unskilled–worker – split-up.

In particular the exogenous wage differential approach comprising more than two labor categories modifies the factor market in the CGE model to a more realistic market.

3.2.3.2 Efficiency Wage Sector (Endogenous Wage Differential)

This modeling idea is based on the so-called efficiency wage theory. The underlying economical approach explains why a profit maximizing firm should pay its workers a higher wage rate than the neoclassical equilibrium wage. In the efficiency wage sector workers have the opportunity to shirk or not to; i.e. in more simple words: either to be lazy or to work efficiently. In order to ensure a high productivity level, producers decrease the payoff from shirking. On the one hand they pay a positive wage differential, on the other hand workers are monitored. If a worker is caught shirking, he is fired and has to move in the competitive sector with the lower (equilibrium) wage level. This strategy increases labor's utility. In equilibrium the wage differential paid to the workers is equal to the utility from shirking. The consequence is no occurrence of shirking at all.

THIERFELDER and SHIELLS (1997) distinguish between two specifications of the monitor part of the model differing by the resulting degree of labor market distortion. The more distorted approach assumes self-monitoring combined with a continuous effort function. Here, an increased wage differential results in an increased effort. Therefore, "(...) the worker in the efficiency wage sector is more productive than his counterpart in the non-efficiency wage sector since the value of the marginal product of labor is higher." The other version – the less distorted one - contains a discrete effort function giving workers the opportunity to either work or shirk. Instead of the wage differential there is an explicit monitor earning the additional payment while producing non-shirking labor.

Generally one can say that the efficiency wage sector approach is a useful tool to picture the labor market in a more realistic and detailed framework.

3.2.4 Unemployment

Although unemployment seems not to fit in a general equilibrium framework, a certain rate of involuntary unemployment is assumed in most of the common CGE models. In the literature this approach is also referred to as the natural rate or equilibrium rate of unemployment. In PHELPS (1968) the conception of this natural rate is sketched as a requirement to achieve equilibrium in the labor market. He argues that a pool of unemployed workers is needed because of the problem of employee turnover. In a situation of very low unemployment job finding is easy. Firms therefore tend to pay more than the competitive wage to keep their employees' quit rate down. According to PHELPS'S theory the equilibrium rate of unemployment is given, when joblessness is low enough so that a firm sets its wage equal to the wage it expects other firms to pay. In the existing literature further modeling extensions can be observed. For example CALVO (1979), who builds a similar model of the natural rate based on shirking instead of quitting. Moreover, like SOLOW (1979), SHAPIRO and STIGLITZ (1984) treat the optimal incentive wage as a function of the unemployment rate. They even further modify the model by taking into account the role of various welfare benefits and assuming all-shirking or no-shirking, endogenous monitoring, risk aversion and endogenous turnover.

BARROS et al. (2001a) incorporate a special feature to ensure involuntary unemployment in equilibrium considering two different alternatives. In the first one a wage rigidity which fixes nominal wages exogenously is assumed. Consequently, since wages cannot adjust it is the employment level that has to change for the sake of an equilibrium situation. The second approach is based on the assumption that the unemployment rate and the wage level are negatively related. This idea is consistent with arguments from the efficiency wage theory described above. In a situation of high unemployment firms do not even have to pay higher attractive salaries to make employees work hard. Since every worker fears to lose his job and then be unemployed, motivation to work efficiently is high anyway. In the case of very low unemployment the situation is similar to PHELPS'S theory and reversed.

Another common tool for analyzing unemployment is the Unemployment – Vacancy (UV) or Beveridge curve where the labor market is characterized by unemployed workers searching for jobs and on the other hand by firms recruiting workers to fill their vacancies. Basically, those two activities fulfill the same "function" like supply and demand where the number of labor demand is given by the number of vacant jobs and labor supply depends on the number of unemployed workers. Models using the Beveridge curve are also referred to as 'search and matching' models since firms and workers are brought together pairwise depending on a certain stochastic 'matching' function. The number of actively searching workers and recruiting firms on the other hand determine the probability of matching a worker – firm pair. In a neoclassical framework, efficiency would prevail and the labor market would clear with perfect matching. Instead, MAECHLER and ROLAND-HOLST (1997) assume that labor market pairing of prospective workers with vacant jobs is inefficient. For modeling purposes they use a specific matching technology which is a function of vacancies, prospective workers and wages, and behaves asymptotic to the number of vacancies. Consequently the labor market cannot clear completely. In MAECHLER and ROLAND-HOLST (1997) this underemployment plus a wage premium is represented in the matching function in the form of efficiency costs of imperfect matching.

3.3 Labor Market Policies

3.3.1 Minimum Wage

Particularly in developing countries, one of the most common governmental instruments of wage rigidity is the minimum wage policy. This is the case when a government fixes a certain wage rate employers are not allowed to undercut. Such a minimum wage can be valid for either the whole economy or just for some specific sectors or industries. Further alternative types of minimum wage policy are discussed in MAECHLER and ROLAND-HOLST (1997). Their modeling approaches will be explained in the following sections.

In the first case they assume that a nominal hourly minimum wage is guaranteed to only one or more specific labor categories, e.g. unskilled labor. They call this specification **'minimum wage by occupation'**. In their model the minimum wage applies to occupational average wages while distributional effects within occupations and inter-sectoral wage differentials are ignored. Since the labor market is split up into three different (labor categories formal unskilled, formal skilled and informal labor) and labor supply is fixed, two model modifications are required. First, the wage equation for the target occupational group – this is where the minimum wage policy is applied - has to be adapted. And secondly, the labor supply equation for the informal occupational group has to be modified since the policy is only effective in the formal sector. The "new" labor supply equation will allow for spillover of unemployed informal workers in the (formal) minimum wage sector.

A small extension of this approach is the **'minimum real wage by occupation'** version. In order to maintain a certain level of real purchasing power MAECHLER and ROLAND-HOLST introduce an additional parameter to their modified wage equation. This parameter represents an endogenous price index drawn from e.g. an aggregate GDP deflator, and thus modifies the nominal wage into a real wage.

The next type of minimum wage policy is similar to the former one. However, a different target group is subject to the policy intervention. This approach deals with a sector specific, e.g. agriculture, applied minimum wage policy: **'minimum wage by sector'**. The changes in the wage equation reflect the inter-sectoral differentials with the equation combining occupational wage and sectoral wage premium. What concerns the remaining equations the modifications are carried out analogously to the changes shown in the previous section.

A further extension taking the real wage into account needs the same adaptations used in the previous approach. In order to model **'minimum wage by sector'** an endogenous price index has to be added.

4.3.2 Labor Union

In the literature, there are already various CGE models which take the existence of labor unions into account. But basically one can distinguish between two approaches to include the union behavior in the model framework: One considers a situation where the union has the bargaining power over wages and the firm has discretion about the employment level. In the other case called the efficient bargaining model both parties have bargaining power over wages as well as employment level.

The first version mentioned is usually called a **'monopoly union model'**. This kind of a bargaining agreement assumes a trade-off between wages and employment, where the union sets the wage unilaterally and the firm decides about the number of workers employed at that given wage level. In their paper MCDONALD and SOLOW (1981) describe this basic approach by assuming that the isoprofit curves of a profit maximizing firm simultaneously represent the firm's indifference curves. Profit is a function of wage (w) and labor (L), and as long as profit stays constant, the firm is indifferent about various wage – labor combinations. Profit (Π) is simply represented by the following function:

$$\Pi = R(L) - wL$$

Profit = Revenue (from Labor) – Labor costs

Consequently, the smaller the wage, the bigger is the resulting profit and therefore firms prefer lower isoprofit curves. Now by quoting a desired wage, the union will achieve that point on the firm's labor demand curve, which represents the employment level where the marginal revenue product of labor equals the wage. In other words, the firm is bargaining along its own labor demand curve and therefore the union can only achieve a point along this curve.

An extension of the prototype model is represented by the determination of the union's wage setting in a less "voluntary" way than described above. This can be done by defining a union's objective and "translating" it into utility function form. The optimal outcome for the union is the wage level that lies at the tangency of the union's indifference curve with the firm's labor demand curve.

For example MCDONALD'S and SOLOW'S (1981) union objective is to maximize the gain from employment over and above a certain unemployment benefit. They choose a standard concave utility function. Furthermore, they examine the nature of wage behavior by changing the demand conditions and afterwards analyzing the effects on the union's wage decisions. Since they assume that the union's decisions are affected via the elasticity of demand for labor and the average wage, they consider a variety of factors. First they introduce an additional parameter to model business cycles and to analyze how the effects are divided between changes in wage and employment level. With respect to the impacts of the average wage the major factor examined is the expected value of alternative employment opportunities. MCDONALD and SOLOW expect procyclical fluctuations due to changes in the probability of finding alternative jobs and in their wages.

DE MELO and TARR (1992) distinguish between two different cases of union's objectives using a generalized STONE-GEARY utility function. In the first case they assume that the union wants to maximize rents and the second approach corresponds to the assumption that the union

maximizes the wage bill. The level of employment resulting from each union – firm bargaining version is achieved analogously to the procedure described above in the part about the 'monopoly union model'. Furthermore, DE MELO and TARR state that actually those two special cases are invalid since generally unions appear to value employment maximization more highly than pure rent or wage bill maximization. Nevertheless, in a model where those cases are taken into account, then the weight assigned to employment in the utility function is probably very high.

THIERFELDER and SHIELLS (1997) model two kinds of passive union behavior using a wage differential to reflect monopoly power in the labor market. In the first case the union's objective is to maximize the wage bill of its members. In their model they assume two sectors, one is unionized while the other one is not. Furthermore, two production factors are used: capital and labor, with labor perfectly mobile between sectors, whereas capital is considered sector-specific. The union has discretion about entry of new workers into its membership and maximizes total labor income to its members by setting the wage according to standard monopoly pricing theory. In the unionized sector the wage differential is modeled endogenously. Analogous to the monopoly union model of MCDONALD and SOLOW (1981) the optimal wage differential depends on the wage elasticity of demand for labor.

In their second approach THIERFELDER and SHIELLS modify the model considering a different specification of the union's utility function. Here the utility function contains a minimum acceptable wage and a minimum acceptable employment level. The interesting point of this specification is that in the case that labor demand in the unionized sector declines, the decline in the wage differential reduces the labor market distortion. This contributes to the welfare gains from such a policy shock.

A similar approach can be studied in DEVARAJAN, GHANEM and THIERFELDER (1997) whereas here a wage differential for each sector is already defined exogenously in the benchmark (no-union) case. For the purpose of modeling the union – firm bargaining an endogenous wage differential is applied.

As already mentioned above there are two different categories of wage bargaining models. The second one is usually referred to as the **'efficient bargaining model'** or also as the **'right-to manage model'**. The expression 'efficient bargaining model' arose in the literature because the monopoly union model is considered not to permit an efficient outcome as a result of a too high wage and a too low employment level. In their paper MCDONALD and SOLOW state that efficient bargains between the two parties are points of tangency between the firm's isoprofit curve and the union's indifference curve. They call the locus of those equilibrium points the contract curve. The final outcome of the bargaining; i.e. the locus on the contract curve at which the firm and the union agree upon depends on the relative bargaining strength of each party.

4. Modeling Labor Issues with GTAP

This chapter represents the empirical part of the paper. First of all the GTAP model used for the extensions and the simulations is briefly introduced. In the second section an explanation of the model design is provided including aggregation and simulation scenarios as well as a labor market extension.

4.1 Theoretical Framework

4.1.1 Standard GTAP-Model

The quantitative analyses in this paper are based on the comparative-static standard multi-regional GTAP model. It provides an elaborate representation of the economy including the

linkages between farming, agribusiness, industrial, and service sectors of the economy. The use of the non-homothetic constant difference of elasticity (CDE) functional form to handle private household preferences, the explicit treatment of international trade and transport margins, and a global banking sector which links global savings and consumption is innovative in GTAP. Trade is represented by bilateral trade matrices based on the ARMINGTON assumption. Further features of the standard model are perfect competition in all markets as well as a profit and utility maximizing behavior of producers and consumers. All policy interventions are represented by price wedges. The framework of the standard GTAP model is well documented in the GTAP book (HERTEL, 1997) and available on the internet (http://www.gtap.agecon.purdue.edu/).

4.1.2 Database

The data set used is the GTAP database version 5 with 1997 as the base year. Basically the data base consists of bilateral trade, transport, and protection matrices that link 66 country / regional economic data bases whereas 14 out of the 66 countries are composite regions, e.g. Rest of Latin America (LAM) or Sub-Saharan Africa (SSA). Moreover, 57 sectors are covered including a very detailed agricultural sector with 12 agricultural primary sectors and 8 food processing sectors. The remaining sectoral part comprises services, manufacturers and other primaries. Finally, besides those country and sector matrices, the database also contains 5 factors, namely, land, capital, unskilled and skilled labor, and natural resources.

4.2 Model Design

4.2.1 Aggregation Strategy

For modeling purposes and in order to channel calculation results the GTAP data were aggregated on a regional and sectoral basis, finally coming down to a 5 regions/ 5 sectors aggregation (see Table 4.1).

Since the main focus of this paper lies on labor and employment issues the regional aggregation has been created taking these aspects particularly into account. There are three types of regions specified which are all differing by income structure: low-income (LOWINCOME), middle-income (MIDDLEINCOM) and high-income (EUHIGHINC) countries. According to chapter 2 of the paper low- and middle-income countries are exclusively represented by Sub-Saharan African regions whereas the European Union (EU) simply takes the part of the high-income economies. Furthermore, the North American Free Trade Area (NAFTA) is included in order to examine eventual impacts on another large trade bloc. The remaining regions are summed up in the Rest of the World (ROW).

What concerns the sectoral aggregation the items comprising one of the 5 sectors were selected according to production quantity, export relevance and labor input in the Sub-Saharan African countries. The reason for this strategy is that the impacts on the interesting aspects of various scenarios are better reflected in the simulation results.

Table 4.1: Regional and Sectoral Aggregation	
Regions	
LOWINCOME	Malawi, Mozambique, Tanzania, Zambia, Zimbabwe, Uganda
MIDDLEINCOM	Botswana, Namibia, Republic of South Africa
EUHIGHINCO	Austria, Belgium, Denmark, Finland, France, Germany, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden
NAFTA	Canada, USA, Mexico
ROW	Rest of the World; all other regions
Sectors	
agriculture	cereal grains nec, vegetables, fruits, nuts, crops nec, sugar, food products nec
manufacture	textiles, wearing apparel, leather products, wood products, paper products, publishing, metals nec, manufactures nec
services	public administration, defence, health, education, financial services nec, air transport, construction, electricity
primary	plant based fibres, wool, silk-worm cocoons, forestry, coal, oil, gas, minerals nec
rest	all other sectors

Source: own aggregation

The factor aggregation of the standard GTAP model remains untouched. Now as before the production inputs are: Skilled and unskilled labor (SkLab, UnskLab), Capital (Capital), Land (Land) and finally natural resources (NatRes).

4.2.2 Model Extension

The labor market in GTAP is a standard basic CGE labor market like already described in chapter 3. Besides, a split-up of the working force in skilled and unskilled labor, there are neither labor market policies nor other employment specific characteristics implemented. This means that a country's employment situation particularly in the case of policy changes and trade agreements cannot be pictured properly. In order to make a first step towards a more realistic representation of a labor market this section introduces an extension in the form of a new variable.

The function of the newly created variable (s_qo) is to calculate the percentage change in total labor demand in a region. Basically 's_qo' sums up the results achieved from another variable (qo) which shows changes in the demand for skilled and unskilled labor. This new variable enables the user to analyze the entire employment situation of a country regarding certain aspects, like e.g. unemployment level, without the skilled/unskilled split-up.

S_qo is modeled via the factor income of labor in one region. Accordingly, two new coefficients had to be defined and a corresponding equation was set up. The new equation (s_qoEQ) calculates the percentage change in total labor demand by multiplying the entire factor income with the share of each labor category in total labor income and finally, summing it up over one region.

4.2.3 Experimental Design

The following scenarios are shaped in a way to show the influence of labor market policies on the outcome of a trade liberalization. Therefore they emphasize how important it is to implement such instruments in CGE models in the course of ex-ante policy analyses.

4.2.3.1 Scenario I (Pure Trade Liberalization)

The first scenario is just an ordinary trade liberalization without any new policies or other feature taken into account. Since agriculture represents a relevant production and employment sector in low-/middle-income African countries, a liberalization shock in this sector is expected to show obvious impacts. Furthermore, in high-income countries particularly in the EU there are still high rates of protection for agricultural products in place. Thus in this scenario the European import tariff applied on agricultural products imported from the defined African regions is reduced by 50%.

4.2.3.2 Scenario II (Trade Liberalization with Minimum Wage)

The next step is the implementation of a minimum wage policy since this instrument is very frequently used in developing countries' as well as in the European labor markets. For the representation of such a wage rigidity two variables were "swapped". This means that one previously exogenous variable became endogenous and vice versa. In this specific case the endogenous variable was the real wage rate (pfactreal) for unskilled labor in both low-income and middle-income countries as well as in the EU (see Table 4.1 for more details). This means that the real wage rate is now fixed. The exogenous variable to become endogenous was the corresponding labor supply (qo).

In addition the same liberalization like carried out in scenario I takes place. Because of this modification of the labor market the results achieved from scenario II are expected to picture the situation in the African regions and the EU after a trade liberalization more realistic than scenario I does. In scenario I any distortions or governmental interventions in the labor market are denied, which consequently has to lead to a distortion of the simulation results.

4.2.3.3 Scenario III (Trade Liberalization with Minimum Wage and Mobility Change)

Finally, in this last scenario another feature is taken into account, namely the mobility of labor. In the GTAP standard model labor is considered perfectly mobile across sectors which is not consistent with the real situation. In reality there exist various factors making labor sluggish to a certain extent. Those are influences ranging from local mobility of workers to special skills needed for production. Thus in the following simulation the mobility of unskilled labor is restricted to -0.6. This extension is analyzed in combination with the minimum wage policy in the course of the same trade liberalization carried out in scenario I and II.

5. Simulation Results

5.1 Results of Scenario I

After the reduction of the European import tariffs on African agricultural items both low- and middle-income regions experience a welfare gain. In contrast, the EU and NAFTA, for them the trade liberalization results in a welfare loss whereas relative to the size of the two trading blocs this loss is marginal. In the low- and middle-income regions this positive welfare effect is particularly caused by terms of trade gains and allocative effects respectively.

Because of better access conditions to the European market the low-income African countries improve their welfare situation through an increased export volume of agricultural goods. Thus they experience positive terms of trade effects. Concerning employment related factors various changes occurred. In the course of increased agricultural production workers are needed in

this sector whereas the demand for unskilled labor rises in particular. The increased demand for labor leads to a positive change in wages and a new equilibrium wage rate for unskilled labor adjusts.

In the middle-income African countries the impacts of the trade liberalization are similar. As the agricultural sector is not of that great economic relevance like in the low-income regions the resulting effects are less significant. While the demand for agricultural labor is relatively higher than in the low-income countries, the impact on the wage level of unskilled and also skilled labor is lower. The same is the case regarding the changes in wage, GDP and regional private household income.

5.2 Comparison Scenario I - Scenario II

This section is supposed to draw out how the outcome of a trade liberalization changes in the case of a minimum wage policy.

Table 5.1: Comparison of welfare decomposition (in $ million) after

	Pure Trade Liberalization				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	9.46	0	47.45	11.94	**68.85**
MIDDLEINCOM	33.11	0	96.85	-7.73	**122.22**
EUHIGHINCO	75.27	0	-110.96	2.8	**-32.89**
NAFTA	-0.76	0	-9.9	-3.54	**-14.2**
ROW	-2.4	0	-23.76	-3.5	**-29.66**
	Trade Liberalization with a Minimum Wage Policy				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	17.84	83.74	45.58	12.47	**159.61**
MIDDLEINCOM	47.57	101.87	99.06	-7.81	**240.68**
EUHIGHINCO	84.41	70.75	-110.85	2.68	**46.99**
NAFTA	-0.78	0	-11.53	-3.71	**-16.02**
ROW	-2.95	0	-22.58	-3.66	**-29.18**

Source: own calculations

First of all, while the situation in the NAFTA and the remaining regions seems pretty unchanged, the welfare gains for the two African regions and the EU achieved from the liberalization increase significantly. In the case of the EU the influence of the wage rigidity is particularly obvious because the EU's welfare situation changes from a former loss to a welfare gain. In both African regions the welfare gain almost doubles. The main reason for these differences is the positive contribution of the changes in endowment use (see table 5.1 and compare column 'change in endowment use') combined with increased allocative effects. A closer look at the changes taken place on the factor level indicates that the responsible factor is unskilled labor exclusively; i.e. the endowment with the fixed wage. The reasons for those positive effects arising through a change in endowment use can be found in the employment and production situation of each country.

In the African regions, similar to the pure liberalization scenario the demand for labor increases because of a higher agricultural production which is necessary to satisfy increased export demand. Since in scenario II the wage of unskilled labor is fixed, no equilibrium wage can arise. Therefore, the labor market has to adjust via the employment level. This means that the additional demand is assumed to be satisfied from the pool of unemployed workers. Consequently the unemployment rate diminishes. Furthermore, the volume of production factors is not restricted

anymore, but increases at a given wage rate. This is also reflected in a higher total production. Compared to the situation without wage rigidity the rise in agricultural production is not accompanied by a rapid decrease in output of other sectors. Since new workers enter the economy the need to draw workers from other production sectors is diminished. Thus the decrease in the manufacturing, primary and other goods production is smaller than after a pure trade liberalization, and the service and capital goods sector even expand production.

Generally, in the EU the effects are the same like in the African regions. Due to the huge total production capacity and the smaller importance of the agricultural sector, the relative output changes are marginal. Nevertheless, with the increased labor force, the EU is able to further increase production in the manufacturing, primary and other goods sector. With the wage rigidity in place the service sector, which accounted for a loss after the pure trade liberalization, now even expands. Besides, the production of capital goods is still lower than before the cut of the import taxes, but the decrease is less significant.

According to the differing changes in the employment level there exist also some differences concerning income and GDP issues. Similar to the employment and production situation described above, there is a difference between the two African regions and the EU with respect to the relative size of the changes. Because of the different roles of the agricultural sector in the countries' economy the effects are much more significant in the low- and middle-income regions than in the high-income region EU. Thus in the former regions, in the case where a wage rigidity is in place both variables experience a significant positive change while after a pure trade liberalization those effects are only marginal. In the EU, the relative impact on both factors is almost zero, whereas the absolute change in the GDP value is twice as high compared to the change after a pure trade liberalization.

5.3 Comparison Scenario I - Scenario III

This section has the same intention like the former one. The main purpose is again to emphasize the importance of a proper representation of the labor market in CGE models. The procedure is conducted by a comparison of the results from Scenario I (a pure trade liberalization) and scenario III (a trade liberalization scenario including a change in labor mobility).

Table 5.2: Comparison of welfare decomposition (in $ million) after

	Pure Trade Liberalization				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	9.46	0	47.45	11.94	**68.85**
MIDDLEINCOM	33.11	0	96.85	-7.73	**122.22**
EUHIGHINCO	75.27	0	-110.96	2.8	**-32.89**
NAFTA	-0.76	0	-9.9	-3.54	**-14.2**
ROW	-2.4	0	-23.76	-3.5	**-29.66**
	Trade Liberalization with Labor Mobility Change				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	9.48	0	52.96	10.46	**72.93**
MIDDLEINCOM	34.16	0	100.22	-7.65	**126.74**
EUHIGHINCO	60.79	0	-115.56	2.7	**-52.06**
NAFTA	-1.83	0	-10.84	-3.19	**-15.85**
ROW	-5.13	0	-27.18	-2.36	**-34.67**

Source: own calculations

In the low- and middle-income regions the mobility restriction on unskilled labor does not induce major changes to the outcome of the trade liberalization scenario. The welfare gain increases to a small extent as a result of higher terms of trade effects. In the EU the former welfare loss caused by the cut of the European import protection gets even enhanced by the lower labor mobility. This happens because on the one hand the positive contribution to welfare of allocational effects is lower, and on the other hand the terms of trade loss becomes higher. Since unskilled labor is now sluggish to a certain extent workers cannot be allocated that flexibly and efficiently across various sectors anymore. This restriction results in a lower positive allocational effect particularly in the agricultural sector. This sector is also responsible at most for the increased negative terms of trade effect resulting from higher world prices of agricultural commodities supplied from the African countries to the European market. Those increased prices arise due to the change in labor mobility. Similar to the pure trade liberalization scenario before, the low- and middle-income countries tend to increase export and therefore production quantities because of the better access to the EU market. Nevertheless, since unskilled labor cannot be drawn from one sector to the now more profitable agricultural sector totally flexible anymore, production is restricted. Thus, trade activities are limited to a certain extent as well. This is reflected in the African regions' comparatively lower production and export volumes. According to this kind of a scarcity of unskilled labor in the agricultural sector, the wage of unskilled labor is higher in this sector than in the other sectors. This high wage is finally the reason for the increased product prices for domestic as well as for export use.

5.4 Comparison Scenario I - Scenario IV

This section provides a comparison of the pure trade liberalization from scenario I with scenario IV including the wage rigidity, the labor mobility restriction and the liberalization. Obviously, the most interesting question with respect to the comparison is whether the different impacts of both labor market extensions sum up or result in a multiplication or compensation effect, respectively.

Table 5.3: Comparison of welfare decomposition (in $ million) after

	Pure Trade Liberalization				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	9.46	0	47.45	11.94	**68.85**
MIDDLEINCOM	33.11	0	96.85	-7.73	**122.22**
EUHIGHINCO	75.27	0	-110.96	2.8	**-32.89**
NAFTA	-0.76	0	-9.9	-3.54	**-14.2**
ROW	-2.4	0	-23.76	-3.5	**-29.66**

	Trade Liberalization with Minimum Wage + Labor Mobility Change				
	allocative effects	change in endowment use	terms of trade effects	changes in investment goods	**Total**
LOWINCOME	19.67	98.5	49.43	11.97	**179.58**
MIDDLEINCOM	52.2	124	102.52	-7.94	**270.79**
EUHIGHINCO	60.21	-2.05	-113.64	2.41	**-53.07**
NAFTA	-1.66	0	-12.33	-3.54	**-17.53**
ROW	-5.3	0	-26.35	-2.93	**-34.58**

Source: own calculations

In the low- and middle-income countries a very significant welfare increase compared to scenario I can be observed. Especially a change in endowment use is responsible for this impact. As

already explained in detail in section 5.2, the change in endowment use is a result of the wage rigidity and an increased supply of employed workers. Indeed, in combination with the assumption that unskilled labor is not perfectly mobile anymore, those endowment use effects are enhanced. The reason is a multiplication effect of wage rigidity and labor mobility change. Since less unskilled workers can be allocated across sectors, the remaining demand for labor in the sectors that experience an additional export demand after the trade liberalization is larger than as if unskilled labor was perfectly mobile. Consequently, even more workers are extracted from the pool of unemployed workers, and thus the entire labor force becomes even bigger. Furthermore, this increased labor force allows for a more efficient allocation of resources accounting for a positive allocative effect.

Regarding the EU shows that a minimum wage policy in combination with a decreased labor mobility even enforces the trading bloc's welfare loss. The major reason for this further loss are the lower positive allocative effects. A detailed explanation of the impacts of restricted labor mobility is provided in the former section 5.3. An evident difference to scenario II (trade liberalization with a wage rigidity in place) is that the change in endowment use accounts for a negative welfare contribution due to a decrease in the EU's entire labor force. This means that instead of new formerly unemployed workers being hired, employed workers get fired, and thus the unemployment rate increases.

6. Conclusion

In each scenario the implementation of the labor market extensions has significant impacts on the outcome of the trade liberalization. In particular resource allocation, usage of endowments and terms of trade effects determine welfare effects and employment situation of each region.

As expected, the cut of the European import taxes on agricultural commodities leads to increased trade activities between the African low- and middle-income regions and the EU. The stimulation of the trade flows results in a welfare gain for the African regions and a welfare loss for the EU. The different labor market extensions modify these results in various ways.

In general, a trade liberalization in the case where a wage rigidity is in place has a positive impact on each region’s welfare situation. The reasons for this effect are a diminished unemployment rate, a larger pool of resources, expanded production capacity and an improvement of resource allocation.

In contrast, the restriction of labor mobility hinders, particularly in the EU, efficient resource allocation. Furthermore, production as well as export capacities are limited and a full expansion of the gains from a trade liberalization cannot be achieved.

A trade liberalization scenario, in the situation where both wage rigidity and a changed labor mobility are taken into account, has opposite impacts on the African countries on the one hand, and on the EU on the other hand. In the low- and middle-income regions where production output and therefore workers are needed, the positive welfare gain is even enhanced. Regarding the EU the situation is the other way around and even leads to a higher unemployment rate after the liberalization.

It becomes obvious that the characteristics of a country’s labor market have a significant influence on the outcome of a trade liberalization scenario. Results achieved assuming a “virgin” employment and labor market situation, can change from a positive to a negative effect or vice versa, when taking some special but realistic labor market features into account. Consequently, in order to represent realistic predictions of the impacts of a new policy or of a trade agreement on a country’s situation those issues have to be taken into account. Particularly with respect to developing countries where sustainability of economic growth and regional development are so closely related to the employment situation and thus the labor markets.

7. References

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