A General Equilibrium Analysis of Globalization on Employment and Income Distribution

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1. Motivation
This study aims at analyzing alternative scenarios of trade and investment policies on regional and sector-specific labor markets, income distribution and poverty in Kazakhstan using the CGE framework. Similar studies based on CGE models have been conducted previously for many other countries. There have been a few attempts at CGE modeling of the Kazakhstani economy, however. This research is the first model of Kazakhstan with detailed division of sectors and more accurate tune-up of the model based on labor market data. It is complemented by micro data from population surveys. The model is used for simulations of trade and industrial policy results in order to analyze their impact on employment, income distribution, and poverty. In comparison with other studies of economic development in Kazakhstan, this emphasizes the issues of industrial protection policy and the effect of the inflow of foreign capital on employment, income distribution, and poverty.

The choice of the method is partly due to the inadequate performance of econometric methods in the analysis of counterfactual policies and in part due to the lack of time series data and good data in general. As for the data, the available series are very short, usually beginning 1994, and suffer from definitional and structural discontinuities during the available period. The statistical authorities do not make disaggregated cross-section or panel data available to the outside researchers. Finally, little variation in government policy over the observed period makes it statistically more difficult to disentangle the response of the economy to policy shocks from the responses to external developments. CGE models are better at capturing general equilibrium
effects than other models. The results are always internally consistent. Static CGE models do not require long time series, and usually all that is needed is the cross-section national accounts and sectoral data on production, income distribution and households’ consumption. From a policy perspective, the CGE approach allows one to simulate policies quite different from what the economy experienced so far. Finally, the assumptions are explicitly made and the results can always be interpreted within the context of the model.

In particular, partial equilibrium models consider only first-round effects of trade policy on the goods market and the cost of living. In his literature survey of trade liberalization’s impact on poverty, Reimer (2002) observed increased recognition by the profession of the fact that the effects on the factor markets become more important for welfare analysis, especially if it concerns the issues of income distribution, poverty, and equality in the long run. “The importance of factor market effects arises because households tend to be much more specialized with regard to factor earnings than with regard to consumption”. The effects of a liberal trade policy are often found to be small and negative for employment and income, especially in the short-run. In the long run, the effects of foreign capital and associated technology transfers, including market institutions, could prove much greater. These effects are known to be notoriously difficult to measure and ascribe to any particular government policy. On the other hand, government trade policy and tariff and non-tariff barriers can be easily measured and have an immediate impact on the welfare of residents. The social demand for the analysis of further opening up of trade regime in Kazakhstan has increased in preparation to accession to the WTO.

In order to capture the salient features of Kazakh economy, the model is explicit in decomposing the sectoral division of the production process that captures the interdependence of the sectors and households through various markets. We originally planned to introduce other components as well, by separating households and production by regions, and by separating labor by the skill level. However, at the stage of gathering data, we found out that data on income distribution by skill level do not match sectoral breakdowns. The economic environment is assumed to be perfectly competitive with restricted labor and capital mobility within the economy.

The data required for building the Social Accounting Matrix (SAM) and calibrating the model has been collected by the National Statistics Agency during the last 3 years. These data include, but are not limited to, Kazakhstan’s Household Living Standards Survey of 2001 and 2002, which cover 12,000 households that represent population by oblast. These data are important for calibrating the composition of the households’ consumption, income and expenditure distribution. Another survey is the Labor Force Household Survey of 2001, which covers approximately 20,000 households. This is needed to calibrate the composition and the structure of the labor force and the distribution of the labor force by household. It also provides the data for elasticity of leisure, consumption substitution, efficient wages, and, possibly, indirectly some other variables, such as labor market frictions and the degree of factor mobility. Finally, the data collected by the Enterprise Labor Force Survey of 2001, 2002 may be used to gauge the amount of labor inputs and labor productivity by enterprise, sector, and region. The living standards survey data is currently available to the research unit for years 2001 and 2002. The disaggregated data that the NSA possesses from both types of labor force surveys remain unavailable to this team. Most parameters of the model will be taken from the aggregate statistics of the two surveys. However, some of the parameters must be estimated using disaggregated data.

Once the model is constructed, debugged, test-run and calibrated, it will be possible to run alternative policy simulations and analyze their effects on income and poverty. The model used is a static one with one time period interpreted either as a long-term steady state or as a short-term response of the economy, depending on the closure. Thus, the welfare analysis is limited to the comparison of before and after consumption patterns, but does not explore the welfare losses during transition.
2. Literature Review

The CGE modeling approach can be summarized as solving a system of equations and inequalities reflecting behavioral, feasibility, and equilibrium conditions for prices and allocations of goods and factors of production. The essential part of the CGE approach is the calibration of the underlying production functions and consumers' preferences, based on actual data. The researcher usually has some freedom in specifying the aggregation, flows of resources within the economy, and the composition of the economy.

A common reference for CGE methods is the Shoven and Whalley (1992) book on applied CGE modeling, which operationalized and standardized the CGE technique. Until the late 1980’s the CGE method was difficult to use for applied economists, largely because of the difficulties of programming the matrix of model’s equations and an interface between the model and the solver. When this problem was resolved by the General Algebraic Modeling System (GAMS), a product developed by the World Bank, the CGE method was applied to a number of economies with a focus on different aspects of structural adjustments. CGE modeling was made yet more convenient by the development of a MPSGE package by Rutherford (1995), which simplified the interface between the researcher and the solver by adding CGE-specific features to GAMS.

Since then, CGE has become not only a tool for studying trade and tax policy but also a tool of analysis of income-distribution schemes. This was mainly due to the fact that the CGE framework allows one to impose economy-wide (governmental) budget constraints on social programs and other income-redistribution programs. Another advantage of CGE models is their ability to handle heterogeneous households with limited income diversification. Such households are especially vulnerable to the declines in the sector-specific returns, such as wages and capital rental rates. Among the first studies that capitalized on these advantages was the frequently cited study by Adelman and Robinson (1978).

A recent paper by Kazybaeva and Tanyeri-Abur (2003) employs the CGE framework to analyze the impact of Kazakhstan’s trade policy on various sectors of the economy. Methodologically, this paper represents a standard approach to CGE modeling with a static environment and perfect competition. The simulation results obtained in this study are consistent with the Hecksher-Ohlin theory and demonstrate efficiency gains associated with commercial liberalization.

3. Data and Methodology

3.1 Methodology

Shoven and Whalley describe the CGE approach as an attempt “to convert the Walrasian general equilibrium structure (formalized in the 1950s by Arrow and Debreu (1954) and others) from an abstract representation of an economy into realistic models of actual economies”. The standard methodology of CGE model analysis includes model formulation, data preparation, calibration, and analysis of policy shock. In this study we generally followed this sequence, occasionally returning from calibration back to model formulation and data preparation, after discovering the lack or inconsistency of the available data.

Our model is also a standard static general competitive equilibrium model of a small, open economy. The model’s parameters are then chosen to match the input-output table of production activities, income distribution data, and consumption and investment data by activities. The data used for calibration were compiled from various sources. This resulted in a slight inconsistency in aggregate numbers obtained from different sources. After data was subjected to certain treatment, the model could be used to analyze policy shocks and exogenous shocks.

A policy shock was modeled as a 5 percent increase in various taxes, both on domestic economic activity and on international trade. The use of domestic taxes in the analysis is motivated by the fact that in general equilibrium changes in domestic taxes may have significant effects on the direction of trade and on the welfare of the workers through the changes in the
pattern of international trade. When one of the mentioned tax rates is increased in one of the sectors, tax rates in the other sectors remain as in the base (calibrated) scenario. We considered the effects of 40 different tax policies. In all cases we looked at the percentage deviation of equilibrium values from the benchmark (calibrated) level. The tax-policy exercise allows one not only to see the policy implications of various tax proposals, but it is also helpful for understanding economic linkages and transmission mechanisms from one sector to another through markets for factors and goods. We decided not to describe the results for a 10 percent tax increase as they essentially doubled the effect of the 5% increase.

3.2 Data Preparation

The input-output (IO) table for Kazakhstan was prepared by the National Statistics Agency on an annual basis, with a lag of one year. We used 2001 data for constructing a social accounting matrix (SAM) because when the data for 2002 became available, most of the work on aggregation had already been completed. The IO table for Kazakhstan consists of two matrices. The first reports the intermediate uses of goods. It consists of coefficients \( a_{ij} \) indicating the amount of good \( i \) used in sector \( j \). The original IO table for 2001 distinguishes 44 activities, which were aggregated into 10 sectors as presented in Table A1, A2, Appendix A. The next matrix indicates the final uses of goods and is presented with same aggregation in Table A3, Appendix A. The coefficients of the matrix of final uses shows the amount of good \( i \) consumed by various final consumers such as households, government, investments, and net exports to the rest of the world. For calibrating the general equilibrium model one also needs the information on income sources for each of the final uses. According to Eurostat standards, these should be reported. Regrettably, the IO data for Kazakhstan omits the breakdown of incomes by income sources.

For tax incidence analysis and assessment of welfare effects it is important to identify major groups of households. This breakdown is not required by Eurostat and is not reported by Kazakh statistical authorities. Every category of household should be characterized by its consumption and income sources. The breakdown must be such that the sum of consumption for all types of households is equal to total private consumption. The same requirement applies to incomes – the sum of households’ incomes should equal aggregate income for the representative household. In order to obtain this information, the data from alternative sources were used. These data were then corrected to fit the aggregate data from the IO table. Finally, the income sources were also distinguished by type of factor (for example, rural labor and urban labor). We obtained the data for two types of households, rural and urban, each endowed with various types of labor, depending on the closure. In one closure of the model, labor is immobile from rural to urban locations. In another, we also assumed that labor is immobile from sector to sector. The data for the benchmark allocation of resources is presented in Table A2, Appendix A.

Different types of general economic equilibrium models can be built based on the information contained in the SAM. A SAM is a single accounting framework which arranges statistical information concerning income flows in a country’s economy within a particular time period (usually a year). It is represented in the form of a square matrix with rows and columns, which brings together data on production and income generated by different institutional groups and classes, on the one hand, and expenditure of these incomes, on the other. The number of rows and columns is flexible, changing in accordance with the nature of an economy and the intended purpose. Any element of the SAM is a receipt for the account specified by the row in which the item is located, and it is an expenditure for the account identified by its column location. An item in row \( i \), column \( j \) is therefore an expenditure by account \( j \), which is received by account \( i \). In the aggregate, within any economic system, all receipts must be matched by corresponding expenditures. Thus, the totals for all corresponding row and column pairs must be equal.

Not all of the interactions between institutions, households, factors of production, and the rest of the world and production activities are presented in the IO Table, if compared with the standards for SAM given by Pyatt and Thorbecke (1976). For example, allocations of factor
income to households, transfers to domestic households from the government and other households, direct taxes on households, etc., are not presented in the IO Table.

An IO Table only shows the relationship between production accounts and the accounts for factors of production, consumption, government, investment, export, and imports. Table 1 illustrates the structure of an IO table, according to the European System of Integrated Economic Accounts (Eurostat, 1986).

Table 1. SAM structure.

<table>
<thead>
<tr>
<th>INTERMEDIATE USE</th>
<th>FINAL USE</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Private</td>
<td>Gov't</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Domestic Production</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Imports</td>
<td>1</td>
<td>D</td>
</tr>
<tr>
<td>Value added: labor, capital, indirect taxes</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>INPUT</td>
<td>J</td>
<td></td>
</tr>
</tbody>
</table>

In the standard Eurostat framework, Matrix A represents intermediate demand. Rows in Matrix A describe output by sector. Columns represent sectors, which use outputs of production as intermediate inputs. A breakdown of a final demand into private consumption, government consumption, investment, and export is shown in Matrix B. Matrix C gives the information on total domestic production. Matrices D, E and F give the corresponding information on imported goods and services. Payments to labor and capital, depreciation, and indirect taxes are presented in Matrix G. Matrix H is normally empty, and the summation over rows in Matrix I gives information on value-added. If an IO Table is balanced, then the columns of Matrix J should be the same as the rows of Matrix C, because total input equals total output for production sectors. A SAM is an expanded version of an IO Table, which contains additional information on interrelations between all accounts. In terms of Table 1, it means that the data for Matrix H is available.

There are several possible ways of measuring values of transactions: basic prices, producers' prices, or consumers' prices. The basic price equals the sum of costs for the goods and services and the remuneration of the factors of production needed to produce that product. Producers' price is equal to the basic price plus net taxes on the products paid by the producer. Consumers' price is the total price paid by the user. It equals to producers' price plus trade and transportation margins. The use of IO Tables for economic analysis may follow different purposes, and so different price systems may be used.
A SAM illustrates the circular process of how demand leads to production, which creates income, which in turn leads back to demand. An IO table has information on income from factors of production (capital and labor), but there is no information on who owns these factors. Among owners are households, corporations, government (which can provide capital and levy indirect taxes), and foreign entities. As such, an IO table misses a link in the distribution of income. A SAM contains additional data on payments among owners. Payments arise from a variety of reasons: ownership of assets, direct taxes on corporations and households, pensions, and transfers. An IO table has information on indirect taxes but not on direct taxes. Indirect taxes are levied on the expenditure by the final purchaser of goods and services or on the sale of intermediate goods purchased by producers. On the other hand, direct taxes are extracted from income and, therefore, constitute a transfer from corporations and households to the government.

In order to obtain Matrix H data and to disaggregate the various households, we used standards-of-living data from the Kazakhstan Households Survey 2001 (HHKS2001). This survey included 12,000 households representing Kazakhstan’s regions by major social groups. Another source was the Labor Force Household Survey of 2001 with coverage of 8,000 households. The Labor Force Household Survey disaggregated the data due to confidentiality concerns. Instead, the NSA aggregated the wage bill by 12 sectors and by location (urban or rural). The breakdown of disaggregated data by standard of living could not be made, because the NSA deems aggregate household income data unreliable. As a result, we had to limit our research agenda to rural-urban breakdown, without considering the distinction between rich and poor. However, it is a safe guess that the relative changes in the welfare of the poor are equal to the changes in real labor income.1

3.3 Calibration
The base run of the model is calibrated to replicate SAM of 2001. SAM is compiled from IO tables. This IO matrix constitutes a part of SAM, which includes productive activities and aggregated labor. The production functions are calibrated using IO tables. However, IO tables will have to be partially simplified. This need is caused by the fact that the IO tables reflect not only the major flows from one sector to another, but also some very insignificant flows. If calibrated to such an IO table, the production model of the economy will not gain much in terms of realism but will lose significantly in terms of simplicity and speed of computation. After these near-zero coefficients are removed, the IO table will need to be balanced.

The cost structure of production activities is determined from the IO table. These include intermediate inputs and factors, such as capital, labor, taxes, depreciation and profit. However, the IO Table produced by NSA shows only aggregate labor and intermediate inputs. The breakdown of income by types of capital and labor are produced using data from the 2001 Household Labor Force Survey and the 2001 Household Living Standards Survey.

In order to calibrate the capital share in each sector, we chose the method of adjusting capital income to balance the leftmost column with the lowest row. That is, if the costs of ith activity did not match the revenues of ith activity, profit of ith activity would be increased or decreased appropriately. The implicit assumption is that the more precise way to measure the value of an activity is to look at revenues, not costs.

A mismatch exists between the sectoral aggregation in the 2001 Labor Force Survey, consumption data from HHKS 2001, and the 2001 sectoral data in IO Kazakhstan. The definitions and the sectoral breakdowns differ in the three sources of data. In terms of SAM, it means that the composition of consumption by rural and urban households that was obtained from HHKS 2001 was not compatible with the data on aggregate consumption by both types of households obtained from the IO table. The HHKS 2001 survey data has consumption categories in terms of final consumer goods, whereas the IO table breaks down all goods by production activities. Moreover, the former cannot be partitioned into the latter. For example, the category

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1 One possible exception could be rural poor in Northern Kazakhstan, who until 2005 could sublease their small land plots to large farmers. With the new Land Code in place, land may no longer be sublet.
“cafeteria” would fall partly into agricultural, partly into manufacturing, and mostly in the private services sector. These had to be apportioned into the above three sectors in such a way that aggregate private consumption is a sum of consumption by the two types of households.

The problem was formulated as a problem of transforming of one type of data into another using a transformation matrix whose coefficients were the shares of production sectors in each of the consumer good categories. This method was not entirely mechanical and required us to make judgments. It was exercised by assigning zeros to most entries in the transformation matrix Table A4, Appendix A. The final result of these adjustments can be seen in Table A1-A3, SAM of the Appendix A.

3.4 Implementation

The solution concept for the model is an Arrow-Debreu (1954) notion of a general competitive equilibrium. It is characterized by a list of prices and allocations (production activities, supply of labor and consumption of goods) which satisfy the requirement that excess supply for every good is non-negative, and that it is either zero or the price of the good is zero. These equilibrium conditions may be written as a Nonlinear Complementarity Problem (NCP), or more generally, Mixed Complementarity Problem (MCP).

MCP formulation lends itself to CGE modeling. The MPSGE package marketed with GAMS for CGE applications is particularly conducive to coding models as an MCP problem. See Rutherford (1995). The model is written in GAMS/MPSGE syntax. Data from IO Tables were transformed from Excel using freeware programs. The PATH solver is used for the computation of equilibria.

4. The Model

The model reflects the salient features of the economy of Kazakhstan. It is static with 10 production sectors and 2 household types. All markets in the economy are competitive. The households provide labor and other factors to the firms. Production units hire labor and other inputs from households in the domestic and import markets and use these inputs to produce their output. Final domestic goods and the aggregate imported goods are combined to produce aggregate consumption good according to the Armington formulation. The output is aggregated and then either consumed domestically or exported. The government collects taxes. The role of taxes is to redistribute income, provide government services, or alter the behavior of the firms and households. This study will not concern itself with the optimal combination of taxes. The exchange rate is normalized to unity. The current account is in surplus equal to the interest payments on net external debt.

Investment is treated differently in different scenarios. In one scenario, in the short-run, investment is fixed at a share of GDP, as it was in the base scenario. In this case, capital and land are constant at the 2001 level in each sector. In another, in the long-run scenario, the capital level is assumed to change to a new steady state equilibrium level, such that the return on capital is tied to the real interest rate. Thus, depending on the closure of the model, one can model long- and short-run effects. While this approach has a shortcoming of not explicitly modeling transitional processes, the static model has an advantage of being simple and easy to calibrate. It must be noted that methods of calibrating dynamic models are far from being generally accepted.

Thus our general equilibrium model has the following features:

- It is static;
- It includes employment and goods markets;
- Urban and rural households both have labor and capital incomes, however, most capital income is distributed among urban households. Urban households also pay direct taxes and make investments;
- The labor market is segregated between rural and urban sectors, but it is not separated across different production sectors;
- Taxes include output taxes, value-added, labor, and an import tariff. Taxes rates are calibrated based on actual tax revenues and the tax base.
4.1 Government

In some simulations, it is desirable to introduce a restriction on tax policy that requires total tax receipts to be no less than some fixed number. The choice of the tax rate then requires at least one tax rate to be variable, rather than a parameter. This is an important issue because the government acts as a welfare transfer authority. In particular, collections of export and import taxes in Kazakhstan constitute almost a quarter of total tax receipts. If tax receipts are included in the total transfer scheme, then trade liberalization may worsen the income distribution via the following channel. Lower tax collections may decrease social transfers and social security from levels under a protected regime. If, conversely, trade tariffs were raised too much, trade would halt with a similar effect on trade and income distribution.

Direct income taxes are used in the presence of WTA to adjust tax revenues up to the benchmark level. That is, if the government decreases import tariffs, the forgone revenues will be compensated by an increase in individual income taxes.

4.2 Labor Markets

In modeling labor markets we employed two alternative closures of the model, in effect looking at two variations of the model. In the first variation of the model, labor is immobile in both urban-rural and sectoral dimensions. This assumption is intended to represent short-run effects on the labor market, which flexibly adjusts the wages but experiences frictions in reallocating labor from one activity to another. This variation is implemented in the model by separating the labor pool into 20 disconnected labor markets, each described by 2 locales (urban/rural) and 10 activities.

The second variation has only two separate labor markets, urban and rural. Workers are free to move from one activity to another in search of higher wages, as long as they remain in the same locale. This variation represents medium-term adjustments, in the course of which the frictions of changing the activity are small compared with the relatively high cost of relocation from rural residence to urban. In fact, by 2001, housing prices in urban areas with rapid employment growth became comparable to the present value of lifetime cash income of a rural worker. This significantly slows the speed of adjustment in the labor market, so much so that two segregated labor markets appears to approximate well the medium term adjustments.

Finally, the total employment remains constant in the model, at the calibrated level of employment, regardless of the policy parameters or other perturbations to the benchmark equilibrium. Admittedly, employment varied greatly over the last 15 years. However, by forcing total employment to stay constant in the model, we emphasize the sectoral reallocation effect of industry-specific taxes and separate it from the effect on total employment. Also, sectoral employment may be more important than total employment in Kazakhstan in the 2000s for the following reasons.

In many regards 2001 is different from the earlier years of transition, when the above model would have been less adequate in describing the labor market processes. In the early 1990s, the number of hired urban workers rapidly diminished. Wagemarkets were leaving their long held jobs because of low real wages and persistent wage arrears. Total employment losses in three years immediately after gaining independence were 1.1 million, and additional 0.5 million in 1997. If all these people remained in the labor force, the unemployment rate would exceed 20 percent by 1998. However, some workers left the labor force and some emigrated from Kazakhstan, keeping unemployment figures relatively low.

In fact, total employment was not a good indicator for the scale of job losses in some sectors. While one industry lost jobs, another gained, keeping the total number relatively stable. During 1991-1999, construction lost more than two thirds of its jobs. Industrial employment was roughly halved in the same period, and is still declining, albeit at a slower rate. The education sector lost almost a half of its employees as well. At the same time, many jobs were created in services and many unemployed became self-employed. Thus, for modeling labor market adjustments in the 1990s, one would have to look not only at the total employment numbers, but at the movement of labor across sectors.
As the economy began to grow in the 2000s, employment grew too, but is not likely to reach the 1990 level because of the changed demographics of the labor force. Still, after several years with a declining unemployment rate, it was still relatively high (8.6% in 2004:Q2). This seemed to indicate that still there was a room for employment growth without overheating, but the data on wages suggested just the opposite. The fact was that since the mid-1990s real wages grew much faster than labor productivity did. This indicated that the labor market could not satisfy the demand for labor while the unemployment remained high. The only reason for this was the large structural unemployment due to the lack of marketable skills of many unemployed.

Thus, we argue that unemployment has approached the natural unemployment level, or NAIRU. In order to increase employment, labor must be either imported or retrained, neither of which are likely to change employment any time soon. Going below NAIRU is likely to overheat the economy and would not be acceptable to the government, which recently committed itself to inflation targeting.

To summarize, because total employment is not likely to increase significantly as a result of tax policy perturbation or additional foreign capital, we excluded this possibility from the model. Instead, we focused on the sectoral reallocation of labor that is likely to continue.

4.3 Trade Policy Scenarios

These scenarios will reflect the policy options, given different combinations of government priorities. The size of the tariff and non-tariff barriers in each sector will reflect the relative importance given by the government to the development of that sector. For example, policy alternatives will include an increase of import tariffs by 100 percent in each sector and all together. To model WTO accession in different scenarios, the tariffs will be reduced in different combinations by 50 percent. Domestic taxation complements trade policy. These should be considered simultaneously.

4.4 Functional Form

Output by the firms is modeled by a Constant Elasticity of Substitution (CES) function in primary inputs, such as labor and capital, and a Leontieff function in intermediate goods. The aggregate output of the sector is transformed by the constant elasticity of transformation (CET) function into consumption goods that are either sold on the domestic market or exported. Households consume various goods and services produced by the firms. Demand is described by household-specific CES utility function. Each of the two types of households has its own utility function, parameters of which are calibrated to 2001 household consumption data.

4.5 Taxation

Tax policy is the part of the model that will be varied for policy simulations. This explains the importance of modeling a tax system as realistically as possible. However, taxation will be modeled in a standard way, which is to say that tax evasion, low compliance, corruption, and informal sector will not be included in the model, at least not in the first version. Tax rates will be calibrated using actual tax collections and tax costs to enterprises. These rates are expected to be significantly lower than the statutory tax rates. Thus, instead of trying to model the taxpayers’ behavior that reduces compliance, the model will account for low tax collection rates. Under this approach, an increase in tax rates may be interpreted as an increase in compliance or as an increase in tax rate.

One has to remember that the statutory tax rates are not very high by international standards. For example, in 2001 VAT stood at 15 percent, social security was 21 percent. Since then, the marginal income tax rates were reduced and corresponding income brackets expanded. Import tariffs, as was pointed out above, have been low on average during the last 12 years and there were no notable changes for any significant groups of goods. The average import tax rate, weighted by imports, was below 10 percent. Accession to the WTO and numerous multilateral and bilateral agreements with Russia and other CIS states are more likely to affect non-tariff barriers and VAT treatment of trade.
4.6 The Theory behind Trade and Foreign Capital Effect on Income Distribution

In the context of a CGE Model, the effects of trade policy on income, employment, and income distribution are determined through parametric analysis of the general equilibrium. Trade policy liberalization will be simulated as a change in the effective import tariff rate for different sectors. The equilibrium that will arise at new tariff rates will exhibit adjustments in virtually every market. For example, it is expected that higher tariffs on agricultural produce will raise domestic food prices and increase the returns on agriculture-specific factors of production and factors used intensively in agriculture, for example unskilled labor. The theory does not say much on secondary effects in other markets linked with the agriculture via factor markets, final good markets, and intermediate good markets. The change in factor prices translates into a change in income distribution among households that have various income sources and often assume the burden of reallocation of resources.

The introduction of some friction in the factor markets constitutes a deviation from the classical framework. In the simulation of long-run closure of the model, frictions are introduced as a cost of reallocation or as a difference in returns to labor in alternative employments. Factors are reallocated if the change in the returns exceeds the differential. In the short-run closure of the model, the cost of reallocation is assumed to be very high, so no reallocation takes place, and a factor price differential could be significant.

The simulation of foreign capital inflows is modeled as the introduction of a foreign-owned productive capital in some sector. For example, foreign capital in the oil sector will increase wages of oil workers and increase returns to factors employed most intensively in the oil sector, however, just as in the case of trade policy simulation, the effects are quantitatively ambiguous. Therefore, we need to compute the equilibrium numerically to assess the potential impact.

It is worth noting that in the case of foreign investment, it is possible to determine which sector would bring the highest returns to foreign investment. However, this requires one to know the difference in technology and productivity of foreign investment capital and domestic capital. The efficiency of foreign investment’s impact as a measure in the simulation depends on the precision of the available data for productivity of domestic capital versus foreign capital. In order to avoid this ambiguity, foreign investment is measured in terms of its marginal product in Kazakhstan, rather than abroad.

5. Alternative Tax Policy Simulations

5.1 Modeling Labor Markets

Because of the methodological difficulties and indeterminacy of modeling long-term effects, we restrict ourselves to the analysis of the intermediate effects of tax policy and analysis of foreign investment effects. The time horizon of the tax experiment is either short or mid-term depending on the closure of the labor market. In the short-term labor is immobile between rural and urban sectors as well as between industries. Thus, in the baseline and the alternative scenarios, labor composition across sectors or locations does not change. As a result, there are 20 separate labor markets (10 sectors*2 locales (urban and rural)). In the mid-term the labor can move from one sector to another, thus reducing the number of labor markets to two, urban and rural.

In this case we are required to explain the urban-rural wage differential, which is quite significant in Kazakhstan. The urban-rural wage differential may be understood as a temporary phenomenon, because the economy in 2001 was not in long-run equilibrium and rural labor was still migrating to the urban areas in pursuit of higher wages. However, the cost of migration from rural to urban location is higher than the cost of changing the job, mainly because the urban destinations with high wages also have higher housing prices. This explanation is also supported by migration statistics. Migration from rural to urban areas was significant in late 1990s and in early 2000s, but the ratio of rural population did not change significantly because of higher rural reproduction rate and emigration abroad from urban areas.
Another reason for urban-rural separation of labor markets is the difference in specialization and skill level. The rural schools do not offer education of quality available in the cities, which contributes to skill and wage gaps. Most rural jobs do not require extended formal training and highly specialized skills. According to the National Statistics Agency, rural-to-rural migration among married adults exceeded the rural-to-urban migration in the late 1990s and early 2000s, but not among single adults. This fact lends credibility to the cost of urban housing explanation because the cost of housing for low singles is much lower than for the married adults. Thus, the costs of housing migration and the lack of marketable skills among rural workers have been responsible for the wage differential in 2001.

However, in the early 1990s net migration from urban to rural areas was observed. It was accompanied by the movement of urban, hired workers to self-employment, despite higher wages in cities. Based on the data from Living Standards Measurement Survey of 1996, Verme (2001) explains this relocation by the dearth of jobs in the cities. While this observation emphasizes the importance of urban unemployment to labor movements in general, presently both the rates of migration from cities to rural areas and unemployment rates have significantly fallen. In light of the recent data on labor movements and wage and unemployment differentials across urban-rural divide, we decided instead to adopt a simpler model with built-in full employment.

The model assumes inelastic labor supply and has no place for unemployment. Full employment in the model is motivated by the following facts of the labor market in Kazakhstan. The relatively high structural unemployment and relatively low total unemployment rate, low minimum wage make the incidence of unemployment relatively low. Thus, using this model we cannot analyze the effects of policies in question on total employment. Instead, we can only see the wage effects and effects of labor reallocation as a result of these policies.

5.2 Modeling Tax Policy
Tax policy simulations included 5 percent increases in various types of taxes – output tax, value-added tax, tax on the wage fund, and import tariffs. The size of the increase was an ad hoc decision partly based on what was considered a reasonable policy change. A smaller change in the rate is rarely worth the implementation costs; a larger change may be perceived as too risky. For example, income and labor tax reductions, implemented in January 2004, were of comparable magnitude. Also, larger increases in the tax rates may produce non-linear response of the system.

For each sector we allowed for a tax rate increase that was similar to preferential treatment or selective subsidies, albeit with an opposite sign. In our analysis we restricted ourselves to taxes in only three industries: agriculture, mining and manufacturing. Thus we conducted $4*2*3=24$ experiments. Their results are included in Appendix B.

We did not analyze the consequences of tax changes on the budget. Instead, we assumed that the government responds to a change in tax revenue with a decrease or increase in the level of government spending. We did not take into account effects of changes in government expenses on public wages, and other administrative expenses, on the welfare of households. In calculating welfare we took into account only that part of government expenses, composed of healthcare and education, both of which were almost purely subsidized by the government.

5.3 Mechanisms of Tax Rate Effect on the Economy
Simulation results show that the extra taxes usually significantly decrease output and employment in that sector and slightly increase them in all other industries. In this case we should distinguish between two effects: direct and indirect.

*The direct effect* is the effect of tax imposition on the taxed sector. The direct effect of output tax, value-added tax and social tax changes across industries. For example, services are notably less sensitive to these taxes, in contrast to good-producing sectors like agriculture, mining and manufacturing. The effect of the product tax has a higher effect (by 30-40 percent) on employment than a tax on labor, and the effect of a tax on labor is significantly lower in
comparison with all other taxes. The explanation is in the difference in the tax base. In everything else, the direct impact of these taxes is similar across sectors.

The indirect effect is the effect of the tax on other sectors. Indirect effects of taxes are usually insignificant and positive. The transfer mechanism of an indirect effect works through the goods and labor markets. For example, the common labor market transfers a tax policy shock to other sectors. An increase in the tax in one industry decreases its after-tax factor productivity. This also decreases wages. Workers begin leaving the taxed sector and enter other sectors until the return to labor is equalized across the sectors. The real wage decreases in every sector. Thus, an increase in tax rates decreases the wages paid in other sectors and acts as a subsidy for the non-taxed sectors.

In addition to the factor markets, transmission acts through markets for final and intermediate goods. As trade and transportation sectors provide services to all other industries, a reduction in economic activity results in lower employment in these sectors and in the sectors that are suppliers and receivers of intermediate goods. In this case, the effect is negative. The total effect is indeterminate and depends on the relative size of the components. Policy simulations show that the total indirect effect is insignificant and much smaller than the direct effect.

The impact of an import tax on employment was similar to a subsidy. However, the size of the impact depended on the sector. For example, a 5 percent import tax increase on agricultural commodities had a small employment effect (0.05 percent only), while a similar protectionist measure for manufacturing increased employment in this sector by 2.5 percent. Overall, the elasticity of the direct employment effect to different taxes and in various sectors was within reasonable bounds. An increase in labor, product and value-added taxes by 5 percent changed employment in the taxed sector from 2.7 to 6.4 percent, depending on sector and tax type.

5.4 Employment and Production

In tax policy experiments, a 1 percent increase in sector-specific employment increases output by approximately one-third percent. The number depends partially on the share of labor in value-added, and partially on the share of value-added in the final product in a given sector. Since sectoral capital is fixed in the short-run, the only factor that affects value added is labor. Usually the labor share varies from 20 percent to 50 percent depending on the sector.

The elasticity of employment in agriculture is the highest. An increase in the social tax by 5 percent, results in an almost 5 percent decline in employment in this industry. In all other industries demand for labor rises. An increase in the production tax by 5 percent in agriculture decreases employment in this sector by 4 percent. In all other industries demand for labor rises slightly.

Employment in the public sector significantly rises with an increase in taxes in other industries. The larger the taxed sector, in terms of employment, the larger is the effect on employment in the other sectors.

5.5 Price Level

An increase in taxes by 5 percent increases the price level from .04 percent, in case of the labor tax on agriculture, to 3.7 percent, in case of the output tax on manufacturing. The variation is due to the differences in types of products, types of taxes (which affect the tax base), their weight in the consumer basket, and the size of the taxed sector.

Taxation in the agricultural sector increased prices for rural households more than it did for urban households. Taxes on manufacturing similarly raised prices for urban and rural households. Taxes on private services increased prices for urban residents more. The main factor here is the difference in the consumer basket of the households. The share of services in the budget of urban households with high income per person emphasizes the prices of services and plays down the prices of food items.
5.6 Wages and Welfare

Real wages were calculated by dividing the index of nominal wages by the consumer price index. An increase in taxes in agriculture decreased the rural real wage by 1.0-1.3 percent and the urban wage rate by 0.0-0.6 percent. A 5 percent increase in taxes on manufacturing decreased real rural wages on average by -0.1 to +1.0 percent. Real urban wages fell by 0.7-2.9 percent, noticeably more than did rural wages. This was to be expected, as most manufacturing workers are urban residents.

Higher import taxes also reduced real wages, with a notable exception of rural wages, in response to protection of agriculture. Thus, protection of manufacturing consisting of a 5 percent increase in the import tariff actually reduced the welfare of the urban poor by 1.1 percent and the rural poor by .6 percent. The negative effect on wages from a protectionist policy is due to the higher effect of protection on the price level compared to employment. If real rural wages could be interpreted as a proxy for the welfare of rural poor, then the rural poor were virtually indifferent to the protection of agriculture. However, one might question the assumption that the rural poor do not have other factors of production than labor.

A value-added tax and a tax on output, in contrast with import and labor taxes, have the biggest negative impacts on the welfare of households. Welfare is defined as consumption of both rich and poor households. For example, a 5 percent increase in the valued-added tax in manufacturing reduces the welfare of urban households by 6 percent and rural by 3 percent. Thus, the negative impact of taxes on real wages is much less than on welfare of households. Even if households are not separated into rich and poor, we may assume that wages are the main income for poor people as capital is for rich people. Thus, an increase in taxes decreases the incomes of the rich more than it decreases the incomes of the poor.

In many developed countries the government protects and supports agriculture even though these measures harm the general welfare of the population. Agriculture is the only sector that uses mostly rural labor. In our model, the protection of agriculture does not create any significant gains or losses in welfare, real wages, or employment in agricultural production. This is because agriculture in Kazakhstan is mainly export-oriented. Our model demonstrates little effect from agricultural protection, at least in the medium term.

We also found a significant difference between the effects of taxation on the rich and on the poor. A 5 percent tax increase caused an overall decline in economic activity and welfare, but this effect was not significant for poor households. These results should be interpreted only as medium-term effects. The model does not allow reallocation, accumulation or investment of capital. Long-run effects of these measures may have repercussions on investment and eventually on the stock of fixed capital. This channel for transmitting the long-run effect of taxation is missing in the short-term models.

6. Simulations of Foreign Investments

6.1 Modeling Foreign Investments

Foreign investments to any particular sectors was modeled by increasing the capital in the industry and by changing the balance of payments so that the income earned by additional capital is considered foreign income. These simulations are called Experiment 3, Appendix D. In order to separate the balance of payments effect from the effect on labor and capital incomes, we also considered the case when capital was increased without the need to pay for it. These simulations are called Experiment 2, Appendix C. The simulations included 5 percent increases in capital through foreign investment in agriculture, mining, and manufacturing. Increasing capital by 10 percent doubles the effect as the system responds almost linearly to perturbations as small as these.

6.2 Employment

As expected, more capital in a sector increased employment. The size of the increase was sector-specific. For example, an increase in capital through foreign capital to agriculture increased agricultural employment by 2.6 percent in urban areas (2.06 percent in rural), 3.7
percent (4.0 percent) in mining, and 3.1 percent (3.6 percent) in manufacturing. The difference in responsiveness in the above sectors is explained through different capital shares and the size of the sector. Agriculture, for example, uses labor intensively, while mining and manufacturing use capital relatively more intensively. We noted before that a 65 percent capital share in the Kazakhstan’s economy is unusually high, when compared to the developed countries, where it normally stands at 35 percent. However, the number is close to the 60 percent observed in Russian national accounts. A relatively high capital share implies that foreign capital effects could be potentially significant. It also means that without an increase in employment, a 5 percent capital increase would result in approximately a 3.3 percent increase in output.

Usually, labor moves to the sector that receives foreign capital. In our model this resulted in lower employment in other sectors. The effect on sectoral employment in other sectors varied from 0.3 to 0.8 percent. For example, an increase in employment occurs not only in agriculture. A 5 percent increase in foreign capital to agriculture, resulted in the highest decrease in employment in rural, non-agricultural sectors (0.4-0.7 percent). Urban employment in agriculture fell by 0.4-0.7 percent after a 5 percent increase in foreign capital to mining, and by 0.6-0.85 percent after a 5 percent increase in foreign capital to manufacturing.

6.3 Production

It is obvious that as foreign capital increases, output and employment in the sector rise as well. Production, however, responds less than employment. For example, a 5 percent increase in agricultural capital increases output by 1.46 percent compared with 2.06 percent increase in employment. Also, agricultural output is less sensitive to a capital increase than manufacturing and mining, while output in all other sectors was reduced due to labor relocation.

A 5 percent increase in capital in the mining sector resulted in 3.5 percent more mining, and a slight decline in the output of the other sectors (less than 0.4 percent) and a decrease of agricultural output. A 5 percent increase in capital in manufacturing increased its output by 2.5 percent, and caused insignificant changes in other industries.

Somewhat counterintuitive is the fact that the volume of production changes less than proportionately. This is because of the low elasticity of substitution in the use of intermediate goods and value-added. In order for a sector to increase its output, the other sectors must also satisfy the increased demand for intermediate goods. Given the fixed pool of labor resources in the economy, the foreign capital recipient sectors will increase their demand for labor, because in our model foreign capital simply increases foreign owned capital.

6.4 Prices

Price level is considered as the nominal price of the consumption basket. In our model we have two different types of households, so we used two different price levels, one for urban and one for rural households. Because money is neutral in this model, supply and demand depend upon real prices, not nominal prices. Price level is used only to determine changes in real prices and real wages.

There are two labor markets (urban and rural) from which all production hires labor, and there are two equilibrium real wages, which clear both markets. In practice, this implies that FDI to a particular sector will increase the real wage, not only in the recipient sector, but also in the whole labor market. While the price of labor increases (or decreases) for all activities, higher wages suppress activity in other sectors. Distribution occurs through the following price mechanism. An increase in capital in one sector leads to higher productivity of labor and higher wages. This attracts workers from other industries. As a result, this industry experiences lack of capital, while others have surpluses of capital. Labor migrates until a new equilibrium price level is reached. Wages will increase in both urban and rural sectors, as virtually all sectors employ both types of labor.

It is obvious that foreign investment in agriculture will mostly affect rural wages, and to lesser extent urban wages. This is because the share of urban labor in agriculture is small and the

\[ 2 \text{ 3.3 percent}=5 \text{ percent tax change}*65 \text{ percent capital-output ratio} \]
capacity of the labor market for urban labor in agriculture is not enough to reallocate urban labor significantly. For example, a 5 percent increase in foreign capital to agriculture increases real wage for rural workers by 0.75 percent, noticeably more than for the urban worker (0.15 percent). Similar results can be observed from foreign capital to manufacturing and mining, which have a predominantly urban base. After a 5 percent increase in foreign capital in mining, real urban wages rose by 0.42 percent, less than the 0.17 percent change in rural wages. After a 5 percent increase in foreign capital in manufacturing, real urban wages rose by 0.63 percent, and real rural wages rose by 0.11 percent.

6.5 Welfare
The model uses a utility function as a measure of welfare. The utility function of the rich and of the poor is identical in this model. The poor have no capital income, while the richer households depend on capital income to various degrees. Wages and rents are the main source of income for the poor. Unlike real wages, the real income of households also includes capital payments less direct taxes and current account surpluses. The impact on the welfare of households with different sources of income will be a linear combination of the effects on the various factors of production. For example, the rural poor own almost a half of the land (if only user rights), while the rich own another half of the land and most of agricultural machinery. However, the results of the experiments reflect only the welfare effects on the two types of households, urban and rural.

The balance with the rest of the world is achieved by equating the present value of current account surplus to the net foreign debt of the economy. Thus, an increase in foreign capital increases net foreign assets in Kazakhstan, and respectively, requires current account surplus to pay for foreign capital. Hence, it reduces welfare of the urban resident. For example, after a 5 percent increase in foreign capital in agriculture, real consumption of urban households decreases and that of the rural households increases. This is due to the lower share of rural households’ capital than that of the urban. Another example: foreign capital in the mining sector generates little effect on welfare, a small increase in urban areas and small decrease in rural.

Changes in the current account can be seen in the comparison of the two experiments, this one and the experiment in which the capital is increased (see Appendix C). In this case there is an increase in welfare. Again, injections of capital into agriculture affected the income of urban and rural households in the same way, even if urban households are the owners of most capital, agricultural also. This is explained through higher effect on rural real wages. Real consumption of rural households from free capital in urban industries (mining and manufacturing) is 1.15-1.35 percent.

Thus, foreign capital increases real welfare of poor households, whose incomes come mainly from labor. It is important to which sector foreign capital was injected. Foreign capital in agriculture mainly improves the welfare of the rural workers, while injections into mining and manufacturing mainly benefit urban residents.

The capital holding households are net losers as a result of importation of foreign capital. First, an increase in the stock of capital decreases its price, while revenues from additional capital are exported as dividends to foreign shareholders. An increase in the stock of foreign capital has almost no effect on households with two types of income, labor and capital, having roughly equal shares. A possible exception may be for rural households that own not only capital, but also land.3

7. Conclusion
The simulation results obtained in the model are consistent with the theoretical

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3 In our model land was considered as capital. With differentiation of capital and land FDI in agriculture will increase not only the incomes of rural workers, but also landowners. Taking into consideration that because of land reform, 1996-2003, many poor peasants are also landowners, the effect of FDI in agriculture on the standard of living for rural poor will be more significant.
expectations and could be a useful tool for policy-making decisions. For the tax policy experiments, the negative impact, in terms of employment, real wages and production, of a tax imposition on the taxed sector was coupled with insignificant changes in other industries. The only exception in this regard was a public services sector, which seemed to absorb most of the labor lost by the taxed sector. In manufacturing, with relatively larger share of urban workers, a tax increase leads to a higher (compared to rural residents) decrease in welfare and real wages of urban residents. In the same way, an increase in the agricultural taxes more adversely affect rural wages and welfare levels. The value added tax and tax on output have larger effect on economic indicators than labor and import taxes.

The sectoral protection, in the form of an import tariff increase, leads to the general decrease in the level of real wages. This exhibits higher impact of price increase compared to nominal wage increase for the industries. In many developed countries the government protects and provides support to agriculture even when these measures harm the general welfare of the population. Agriculture is the only sector that uses mostly rural labor. In our model, protection of agriculture does not create any significant gains or losses in welfare, the real wage, or employment in agricultural production. This is because agriculture in Kazakhstan is mainly export-oriented. Our model demonstrates little effect of agricultural protection, at least in the medium term. We also found a significant difference between the effects of taxation on the rich and on the poor. A 5 percent tax increase causes an overall decline in economic activity and welfare, but this effect was not significant for poor households.

Policy scenarios with foreign capital injections into agriculture, mining and manufacturing are consistent with the results of a vertical model of FDI. The magnitude of the percentage increase in employment and production as a result of foreign capital depends on the share of capital and the size of the sector. Labor moves from other sectors to the recipient sector. An increase in foreign capital into agriculture resulted in a greater decrease in employment in rural non-agricultural sectors compared to the urban sectors. Production changes by a smaller degree than employment. Foreign capital increases real welfare of poor households, whose incomes come mainly from labor. It is important to which sector foreign capital is injected. Foreign capital into agriculture, with relatively larger share of rural workers, will improve the welfare of the rural workers by a higher percent than that of the urban workers. In the same way, foreign capital injections into mining and manufacturing will mainly benefit urban residents.

Capital owners are net losers because the importation of foreign capital reduces the returns to capital. Foreign capital has almost no effect on households where there are two types of income, from both labor and capital. A possible exception may be the rural households that own not only capital, but also land. For these households, importation of foreign capital increases welfare unambiguously.

8. Bibliography


