The Impact of Korean Unification on North Korea

A Scenario Approach Using an Interindustry Macroeconomic AGE Model of North Korea

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Background

There is perhaps no economy about which so little is known as that of North Korea. However, from a policy perspective, the North Korean economy is one of the most important for us to understand. News accounts in *The Economist* and *Far East Economic Review* describe extreme food shortages, and show pictures of starving young children. On the other hand, real resources dedicated to the military have apparently increased during the 1990s. Before the partition of Korea in 1948, the North had the most industrial resources, had more highly developed heavy industry, extraction and power generation, and had a higher level of per capita income than the South. In fact, as recently as the late 1970s, the level of income in the North was still estimated by many observers to be higher than that of the South. However, in the 1980s, South Korea was booming, and North Korea relatively stagnant. To the extent that growth did occur in the North, it was assisted by foreign aid and barter arrangements with both the Soviet Union and China. Since the breakup of the Soviet Union in 1990 and a relative cooling of relations with China, this aid flow has largely ceased. That, combined with a number of years of adverse agricultural conditions, has led to declining GDP and sharply reduced availability of food and consumer goods. Widespread famine has only been mitigated by contributions of food aid from the U.S., Japan and South Korea.

What these adverse economic conditions mean for the political survival of Kim Jong Il or the communist regime in North Korea is unclear. Some think that economic difficulties will encourage rapprochement or cooperation with the South. In recent years there have been increased hopes that the long-awaited Korean unification may finally occur. On the other hand, it is possible that good harvests will return, and the North Korean leadership can continue to muddle along for another decade or so, making occasional small concessions in return for aid from the West.

Overview

This study has 3 objectives: 1) develop industry and macroeconomic estimates of data for North Korea; 2) construct an interindustry macro applied general equilibrium (IMAGE) model for North Korea in the INFORUM framework; and 3) use this model to examine alternative scenarios for Korean Unification. The next section of this paper describes the development of the data set, in conjunction with further tables and notes in Appendix A. Since there is an almost total blackout of economic information from North Korea, the development of this data set is necessarily tentative, and I would welcome suggestions that would enable us to improve upon these estimates. Following the data section is a description of the development of the model. The model is rather simple in structure, and incorporates no econometric equations. However, it is capable of modeling trade, foreign investment and production realistically, for 11 industries. Next is a discussion of the 4 scenarios developed for this study, which combine high and low assumptions for two important dimensions:

the degree of foreign aid and investment, and the speed at which total factor productivity in the North may approach that of the South. The final section summarizes raises some further issues not treated in the scenarios, and offers some suggestions for future research.

Development of Economic and Demographic Data for North Korea

The starting point for the data development for North Korea was the base year data set for an AGE model of North Korea, developed by our South Korean colleagues, Dr. Dong-Cheon Shin and Dr. Young Sun Lee for a joint research project. The data consists of an 11-sector I-O table, final demands and value added for North Korea for 1990, converted to U.S. 1990 dollars. Coefficients of the I-O table were developed using data from an I-O table of China, scaled to be consistent with estimated North Korean aggregates. Table 1 shows a summary of GDP by final demand category for 1990, in millions of U.S. dollars. Appendix table A-1 shows the estimated I-O table for 1990.

Table 1. Final Demand Components of GDP in North Korea: 1990

	Cons.	*Inv.*	*Gov.*	*Exports*	*Imports*	*Final Demand*
1 Agriculture, forestry and fisheries	3921.2	11.4	.	409.9	285.1	4057.4
2 Mining	.	1.9	.	200.8	480.5	-277.8
3 Food & beverages	1451.8	144.0	.	0.5	5.7	1590.6
4 Light industry	1011.6	79.6	.	833.9	670.9	1254.2
5 Chemicals & petroleum products	472.9	11.4	.	27.1	91.5	419.9
6 Primary metals	.	.	.	172.1	.	172.1
7 Metal products and machinery	682.5	3342.5	.	197.3	987.5	3234.8
8 Other manufactures	120.9	35.1	.	11.5	66.8	100.7
9 Utilities	220.0	.	.	.	.	220.0
10 Construction, transportation and communication	550.3	5654.8	.	.	.	6205.1
11 Commerce & services	2596.9	196.2	3403.1	.	.	6196.2
	11028.1	**9476.9**	**3403.1**	**1853.1**	**2588.0**	**23173.2**

Total GDP in 1990 is estimated to be about $23.2 billion, less than the total sales of the Daewoo corporation, according to a recent *Washington Post* article. Consumer expenditures are estimated to be a little less than half of GDP ($11 billion), investment is $9.4 billion, and government consumption expenditures are $3.4 billion. Since North Korea is a planned economy, the investment is government financed as well. Net exports are estimated to be negative ($-.7 billion), with the largest trade deficits in the Metal products and machinery and Mining sectors. Imports in the latter sector are comprised largely of crude petroleum.

Table 2 shows the estimated breakdown of GDP in terms of value added by industry. The value added of capital is the total surplus collected by the government, including depreciation. Value added of labor consists simply of wage payments. Note that in North Korea, about 75% of GDP is return to capital, as compared with about 35% in the U.S., and about 50% in South Korea and Japan. Almost one fourth of total value added is in the Agriculture, forestry and fisheries sector. Other large sectors are Commerce and services, Construction, transportation and communication, and Metal products and machinery.

Table 3 below shows some of the macroeconomic relationships in the data set, which help in deriving a time series of data, as well as to bring the model to closure, as described in the next section. The first section of the table shows the components of government expenditures. Total government revenue is defined to be equal to total return to capital, since there are no taxes, and the government receives the full surplus from production. The government also sets aside savings, which will be used for investment, and provides a certain level of subsidies to consumers. Government consumption includes current government expenditures on salaries as well as goods and services which are not durable investments. The second section of table 3 shows the sources of household consumer income as the sum of labor return by industry and government subsidies. The third section of the table shows the investment savings identity, with total investment defined to be equal to government savings plus foreign savings (imports - exports).

A time series of industry and macroeconomic data was obtained by starting with estimates of aggregate GDP, exports, imports, and total return to capital, which were available from the *Statistical Yearbook* published by Bank of Korea, from 1980 to 1994. These numbers were used to move the 1990 base year data forward and

Table 2. Value Added Components of GDP for North Korea: 1990

		Labor	*Capital*	*Total*
1	Agriculture, forestry and fisheries	3357.3	2005.6	5362.9
2	Mining	141.7	637.1	778.8
3	Food & beverages	55.5	1261.4	1316.9
4	Light industry	201.3	1321.5	1522.7
5	Chemicals & petroleum products	59.7	1134.0	1193.7
6	Primary metals	144.0	568.2	712.2
7	Metal products and machinery	359.7	2311.1	2670.8
8	Other manufactures	292.8	323.1	615.9
9	Utilities	75.6	174.4	250.0
10	Construction, transportation and communication	769.2	3171.4	3940.7
11	Commerce & services	1109.4	3687.4	4796.8
	All Industries	6566.1	16595.1	23161.2

Table 3. Macroeconomic variables: 1990

	1990
Government revenue (= total capital return)	16595
Government savings	8753
Subsidies to consumers	4449
Government consumption	3393
Total labor return	6566
Subsidies	4449
Total household income (= total consumption)	11015
Government savings	8753
Foreign savings (= imports - exports)	731
Total investment	9484

backward. Since there are no data available for either industry or aggregate prices for North Korea, prices were assumed to be constant, at the 1990 level. Total return to labor was assumed to be equal to GDP less total return to capital. Total household income, which equals total consumption, was assumed to be equal to total labor income plus a subsidy from the government, which is a constant share of labor income. Total government revenue is equal to total capital return, and government savings are assumed to be a constant fraction of government revenue. Government consumption is derived as a residual, after subtracting subsidies and government savings from government revenue. Foreign savings is derived as total imports less total exports. Total investment is equal to total savings, which is the sum of government savings and foreign savings. All industry level time series except for output were derived using constant industry shares multiplied by the corresponding aggregate. Output was calculated as the sum of calculated intermediate and final demands.

Figures 1 to 4 summarize some of the main components of GDP, estimated from 1980 to 1994. GDP by these estimates was in fact rising at a health pace until 1990, turning down in 1991, and then more sharply in 1992. The estimate of total investment keeps rising until 1992, when it flattens. Consumption, on the other hand, drops sharply from 1991 to 1993, declining by nearly 72%! Net exports remain slightly negative throughout the period, but turn up on 1988, and rise gently after 1990.

One can, and perhaps should, doubt the validity of these numbers. However, they are based as far as possible on data published by South Korea. These in turn, are based on reports by the North Korean government combined with intelligence gathered by South Korea. As described above, total consumption is derived by first deriving labor income (GDP - capital income), and then adding estimated subsidies. The drop from 1990 to 1993 may actually not have been as severe if: 1) GDP growth had actually been higher than estimated; 2) capital income had not grown as fast as estimated; or 3) subsidies would have actually risen in response to deteriorating conditions. Table A-2 in the data appendix contains a series of macroeconomic data for selected years.

Historical data on total population and labor force is taken from the *Statistical Yearbook*. Projections of these variables are taken from Eberstadt (1995). Total population in 1994 is estimated to be about 23 million, and the labor force estimate is about 10.4 million. We have no information about unemployment or participation rates of the working age population, either in the database or in the model. However, there are two inferences made by Eberstadt that bear comment. Using demographic modeling techniques, he was able to detect about 1.3million males missing from the reported population and labor force. Presumably, these males are in the Korean People's Army, or in some auxiliary military function, where they are not reported. The correlate to this is that the measured labor force has a high share of women, perhaps as much as 60%.

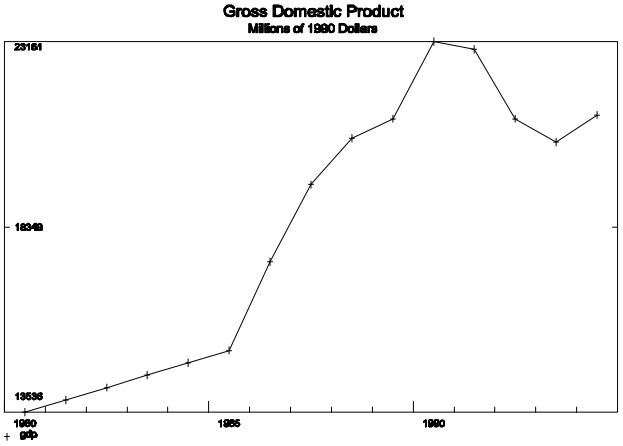

Figure 1

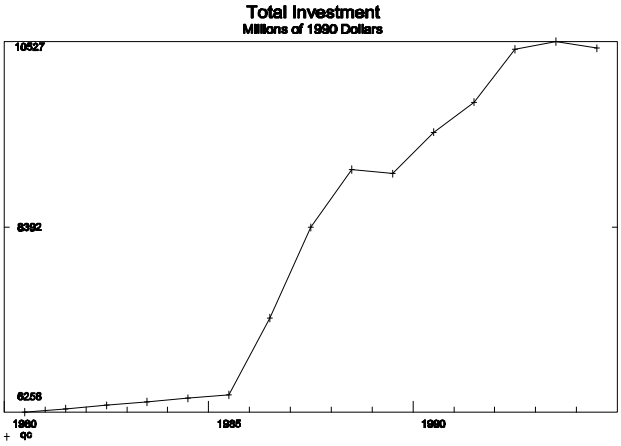

Figure 2

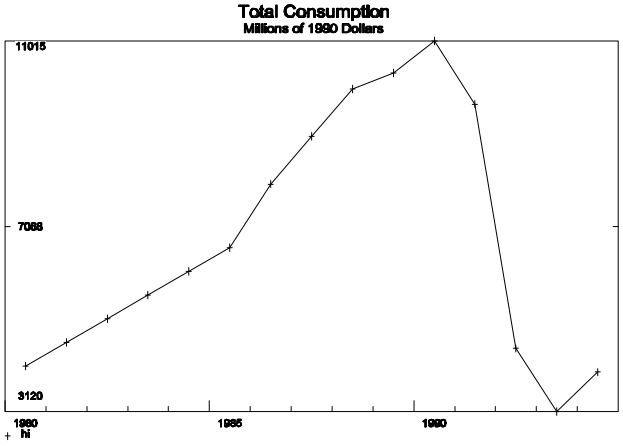

Figure 3

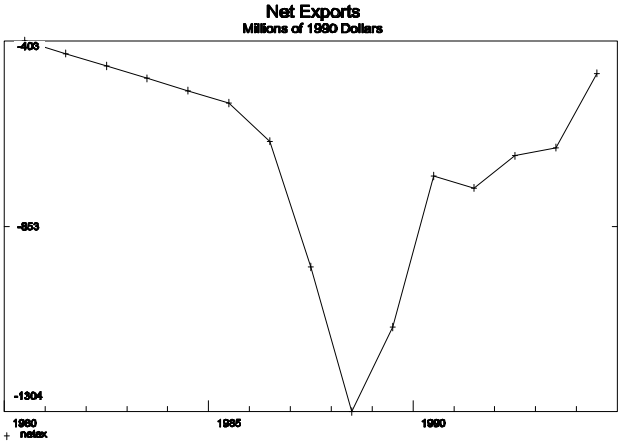

Figure 4

How well does these data match other published series? The total GDP figure is similar to that in the CIA World Fact Book, and roughly in line with GDP estimated by Hwang using the trade exchange rate.[1] Lee (1994) contains estimates of GNP and total investment, taken from the South Korean National Unification Board (1991). The GNP series matches our GDP series quite closely, except in 1983, where his figure is $18.1 billion, as opposed to our $14.5. Lee's investment series is slightly higher than our source, but only by about 5% to 10%. Hwang (1993) compares estimates of GDP for North Korea from several separate sources. He has a different estimate than Lee from the National Unification Board, which is somewhat higher than our series in the last year of data (1990), but is $14.7 billion in 1983. Other estimates listed in the table end between 1979 and 1987, but the range for 1983 is between $16 billion (Stockholm International Peace Research Institute, 1987) and $22.4 billion (CIA, 1985).

[1] Hwang (1993), p 120. The GDP figure obtained using the official exchange rate is almost twice this figure. I have not been able to find any estimates based on PPP.

The model that was developed for this study is a hybrid between the typical INFORUM interindustry macroeconomic (IM) model, as described in Almon (1991), and standard general equilibrium (AGE) models. It borrows from the INFORUM models the sequence of projecting final demands at the industry level, then jointly solving for output and imports, and then building up macroeconomic aggregates from industry projections. However, unlike most INFORUM models, there are no estimated econometric equations in this model, but important relationships are specified by the model builder.

Central to the long-run properties of the model is the specification of a CES production function for each of the 11 industries in the model, with total value added a function of capital and labor inputs. To obtain the function for each industry, we estimated an aggregate CES production function for both North and South Korea, using time series of labor and capital inputs, as well as payments to labor and capital. The estimated elasticity of substitution for South Korea was used for both countries, and, and the efficiency parameter and distribution parameter were calibrated to fit the data in each year, as described below. Table 4 shows a comparison of the capital and labor inputs and returns for North and South Korea for selected years. All figures for South Korea have been converted to 1990 constant dollars. The column labeled "labor" shows total employment in thousands of persons, and the column labeled "capstk" shows estimated capital stock in billions

Table 4. Capital and Labor in South Korea and North Korea

South Korea

	labor	*capstk*	*labinc*	*capinc*	*pl*	*pk*	*K/L*	*K/Q*
1980	13507.8	156913.3	18891.4	24137.9	1.399	0.154	11.62	3.65
1985	14909.3	247111.8	39560.8	48844.9	2.653	0.198	16.57	2.80
1990	18084.9	427861.3	101150.9	103572.2	5.593	0.242	23.66	2.09
1991	18612.0	490090.3	125306.6	121727.5	6.733	0.248	26.33	1.98
1992	18961.0	544199.3	140918.3	134837.3	7.432	0.248	28.70	1.97
1993	19253.1	595405.3	154887.9	150248.0	8.045	0.252	30.93	1.95
1994	19836.9	653095.5	175383.3	170467.1	8.841	0.261	32.92	1.89

North Korea

	labforce	*capstk*	*labinc*	*capinc*	*pl*	*pk*	*K/L*	*K/Q*
1980	7005.0	137533.8	2439.0	11097.0	0.348	0.081	19.63	10.16
1985	8339.0	136023.6	3943.3	11197.0	0.473	0.082	16.31	8.98
1990	9652.0	150681.9	6566.1	16595.0	0.680	0.110	15.61	6.51
1991	10083.0	154477.5	5765.7	17195.0	0.572	0.111	15.32	6.73
1992	10430.0	159052.8	2661.3	18495.0	0.255	0.116	15.25	7.52
1993	10190.0	163358.8	1859.8	18694.0	0.183	0.114	16.03	7.95
1994	10369.0	167148.5	2361.7	18894.0	0.228	0.113	16.12	7.86

of dollars.[2] The labor force for South Korea is about twice the size of that of North Korea, which is consistent with their relative populations. The columns labeled "labinc" and capinc" show total labor and capital income for both countries. Capital income for South Korea was obtained by summing depreciation and profits. The columns labeled "pl" and "pk" are the real wage and capital rental rates, obtained simply by dividing labor and capital income by the quantities of labor and capital respectively. For example, in 1990, the average real wage in South Korea was $5593 per worker, while in North Korea it was $680. The capital rental rate includes depreciation, which we have assumed to be about 10% per year. If this assumption is correct, then with a rate of return of only .11 in 1990, the North Koreans are barely covering depreciation. The South Korean rate of return of .25 in 1990 however, is quite healthy.[3] The columns labeled "K/L" and "K/Q" are the capital-labor ratios and capital-output ratios, where output is total value added. The K/Q ratio is much higher in North Korea, but this merely indicates that the use of capital must be very inefficient there. The K/L ratio is expressed in thousands of dollars of capital stock per worker. This ratio was actually higher in North Korea in 1980, but as investment took off in the 1980s in South Korea, the K/L ratio eventually reached a level about double that in the North.

When we look at the scant returns to capital and labor in North Korea, compared to South Korea, it is apparent that a different production function must hold in each country. One simple way to estimate the extent of this difference is to use a parametric approach. We chose to use the Constant Elasticity of Substitution (CES) production function because it is relatively simple, while still allowing for labor and capital shares to change over time. The function takes the general form:

$$Q = \gamma\left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right]^{-\frac{1}{\rho}} \qquad \textbf{(1)}$$

Where Q is the quantity of output, K is the quantity of capital and L is the quantity of labor. The constant elasticity of substitution is:

$$\sigma = \frac{1}{1+\rho} \qquad \textbf{(2)}$$

The parameter γ is generally known as the *efficiency parameter*, and is related to the concept of total factor productivity. The production possibility frontier of the function will be further from the origin, the higher this parameter. The parameter δ is also known as the *distribution parameter*, and is related to the cost shares of the factors. Assuming constant returns to scale and competitive markets, we can estimate σ with either of the following two regression equations, using the marginal productivity conditions from the production function:

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[2] Capital stocks for both countries were calculated from time series investment data, assuming a depreciation rate based on an average economic service life of 10 years.

[3] The rate of return similarly calculated for the U.S. was .20 in 1990.

$$\ln(Q/K) = a_1 + \sigma_1 \ln(P_K/P_Q)$$
$$\ln(Q/L) = b_1 + \sigma_2 \ln(P_L/P_Q) \qquad \textbf{(3)}$$

In general, the two estimates of σ will be different. However, we can estimate the two equations jointly, constraining the sigma in both equations to be the same. Using this technique, I obtained a value of σ for South Korea of .73. A similar exercise was performed on the North Korean data, yielding an estimate for σ of 1.3.[4] As this estimate is rather high, and since we have less confidence in the North Korean price data, the South Korean value for σ was used for both countries. Values for the distribution parameter and efficiency parameter were then calibrated to fit the historical data for both North and South Korea.

Table 5 shows the calibrated relative efficiency parameter ("gamma"), the marginal product of labor ("MPL") and marginal product of capital ("MPK") calculated for each country, for selected years. The calibration was achieved by using the marginal productivity conditions from the CES function, and setting the rate of return of each factor equal to its marginal productivity. According to the measure of efficiency represented by γ, the South Korean economy was about 4.6 times as productive as the North in 1980. In 1990, before the sharp decline in the North, the productivity factor was 5.6. By 1994, however, the ratio of South to North is almost 12! This is due to the fact that productivity in the South has continued to rise at the same time that the North

Table 5. Efficiency of North and South Korea Compared

South Korea

	gamma	*MPL*	*MPK*
1980	0.643	1.399	0.160
1985	0.914	2.653	0.200
1990	1.492	5.593	0.243
1991	1.673	6.733	0.249
1992	1.735	7.432	0.249
1993	1.767	8.045	0.253
1994	1.848	8.841	0.262

North Korea

	gamma	*MPL*	*MPK*
1980	0.140	0.348	0.081
1985	0.183	0.473	0.082
1990	0.265	0.680	0.110
1991	0.239	0.572	0.111
1992	0.167	0.255	0.116
1993	0.148	0.183	0.114
1994	0.156	0.228	0.113

[4] The price of output for the North Korean regressions was assumed to be unity.

Korean economy has gone into a tailspin.

The CES function presented above for aggregate economy data was also calibrated to fit the data for each of the 11 industries in the North Korean I-O data. The industry functions are used to calculate the productive capacity of each industry, as well as the capital and labor income generated in production. Unlike a typical interindustry model, which is demand driven, and in which supply is infinitely elastic, this model assumes that in the short-run capacity is fixed, and can only be increased over time by more capital investment, a larger labor force, and a higher efficiency of production. In the input-output solution, domestic output and imports are solved simultaneously. As long as the demand for domestic output so calculated is less than or equal to capacity output, imports are calculated as a certain share of total domestic demand. However, if total demand would result in a domestic output that is greater than capacity, a supply constraint will hold, and the extra demand must be satisfied by imports. As we shall see below, the amounts of foreign aid and foreign investment assumed in the four scenarios are huge, in relation to the current scale of production in the North Korean economy. By modeling the supply constraints explicitly, the economy cannot grow faster than its productive capacity will allow.

In each period, the capital stock in each industry is increased by the investment in that industry, and depreciation is removed. The investment in each industry is a fixed industry share of total investment, which is equal to total saving. The investment savings balance in this model is automatically satisfied by design. Total investment is constrained by the equation:

$$inv = gs + fs - aid - fdi$$

where: *inv* = total investment
gs = government savings
fs = foreign savings (= imports - exports)
aid = foreign aid
fdi = foreign direct investment

Thus, the investment savings balance is closely coupled with the external balance, as there are no consumer or business savings in this model. The two balances taken together result in the constraint that foreign aid and foreign direct investment that cause consumption plus investment to be greater that production must result in imports. This is also consistent with the mechanism for calculating output, described above. As long as large amounts of aid are provided to North Korea, we must also expect to see large imports, until productive capacity eventually rises.

Exports are calculated in two parts. The first part is exogenous, and growing at a rate which can be fixed by assumption. The other part is sensitive to foreign direct investment (FDI). We assume that the purpose of FDI is to generate future capacity for exports. Therefore, the total capital stock for each industry is divided into capital stock arising from FDI, and other capital stock. The capital stock from FDI is assumed to be devoted to exports, and can generate exports at the same capital-output ratio as production for domestic use. As in the calculation of the historical data, household income of consumers is calculated as total labor return plus subsidies from the government. We assume there are no taxes. Consumption by industry is allocated using a vector of fixed shares.

Description of the Four Scenarios

For the purpose of examining the impact of Korean unification on the North Korean economy, four scenarios were developed, which varied along two dimensions: 1) degree of foreign aid and foreign investment ("resource transfer"); and 2) rate of growth of total factor productivity and flow of workers ("liberalization"). Unification is assumed to occur in 1998, and the period of analysis is 1998 to 2010. By "unification" we mean that the North Korean economy will be controlled by South Korea, but that it will remain as a discrete entity, with restrictions on cross-border flows of people. For the purposes of this study, the structure of the North Korean economic accounts will remain the same as before unification. However, we recognize implicitly that the form of the economy will change abruptly from a command and control economy to a capitalist economy with strong government, as seen in the economies of Japan or South Korea today. Table 6 below summarizes the assumptions used in the four scenarios. Figure 5 summarizes each scenario in terms of the two dimensions.

Note that in the *large resource transfer* scenarios, $49 billion per year is transferred as aid, and up to $21 billion FDI is invested. In the *small resource transfer* scenarios, up to $17 billion per year is transferred, and up to $10.035 is invested. In either case, one should keep in mind that these are very large numbers in relation to GDP between $21 billion and $23 billion in the past few years. To my knowledge, there are no historical examples we can use for reference in which the size of transfers and FDI have been so large in relation to GDP.

Figure 5

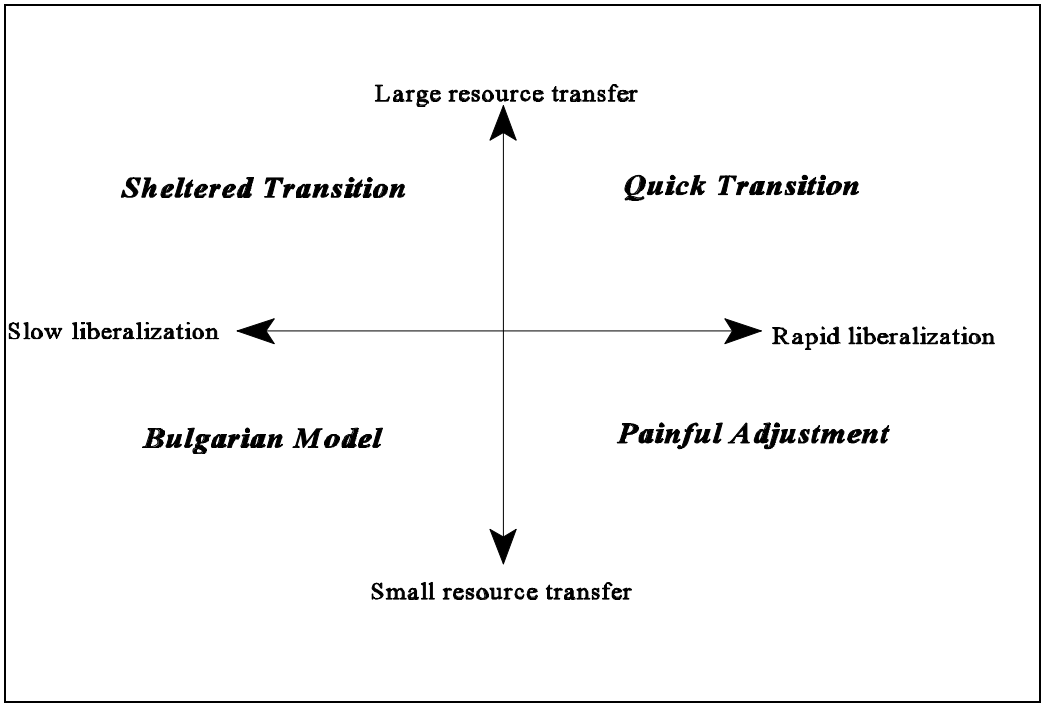

Table 6. Assumptions for the Four Scenarios

Quick Transition *Large resource transfer* *Rapid liberalization*	**Financial Aid:** From the South: $45 billion per year From Japan, U.S. and World Bank: $4 billion per year **Foreign direct investment (FDI):** From the South: 1998: $5 bil.; 1999: $10 bil.; 2000: $15 bil; and 2001-2010: $20 bil. per year. From elsewhere: 1998-2010, $1 bil. Per year **Labor:** Maximum flow of North Korean workers to the South: 1998: 25 thous; 1999: 212 thous; 2000: 400 thous; and 2001-2010: 800 thous. **Total Factor Productivity:** TFP or North rises to 2/3 of 1994 Korean level by 2010.
Painful Adjustment *Small resource transfer* *Rapid liberalization*	**Financial Aid:** From the South: $15 billion per year From Japan, U.S. and World Bank: $2 billion per year **Foreign direct investment (FDI):** From the South: 1998: $2.5 bil.; 1999: $5 bil.; 2000: $7.5 bil; and 2001-2010: $10 bil. per year. From elsewhere: 1998-2010, $0.35 bil. Per year **Labor:** Maximum flow of North Korean workers to the South: 1998: 25 thous; 1999: 212 thous; 2000: 400 thous; and 2001-2010: 800 thous. **Total Factor Productivity:** TFP or North rises to 2/3 of 1994 Korean level by 2010.
Bulgarian Model *Small resource transfer* *Slow liberalization*	**Financial Aid:** From the South: $15 billion per year From Japan, U.S. and World Bank: $2 billion per year **Foreign direct investment (FDI):** From the South: 1998: $2.5 bil.; 1999: $5 bil.; 2000: $7.5 bil; and 2001-2010: $10 bil. per year. From elsewhere: 1998-2010, $0.35 bil. Per year **Labor:** Maximum flow of North Korean workers to the South: 1998: 25 thous; 1999: 62 thous; 2000: -2010: 100 thous. **Total Factor Productivity:** TFP or North rises to ½ of 1994 Korean level by 2010.

Table 6 (continued). Assumptions for the Four Scenarios

Sheltered Transition *Large resource transfer* *Slow liberalization*	**Financial Aid:** From the South: $45 billion per year From Japan, U.S. and World Bank: $4 billion per year **Foreign direct investment (FDI):** From the South: 1998: $5 bil.; 1999: $10 bil.; 2000: $15 bil; and 2001-2010: $20 bil. per year. From elsewhere: 1998-2010, $1 bil. Per year **Labor:** Maximum flow of North Korean workers to the South: 1998: 25 thous; 1999: 62 thous; 2000: -2010: 100 thous. **Total Factor Productivity:** TFP or North rises to ½ of 1994 Korean level by 2010.

Simulation Results

Summary macro tables and graphs of the results can be found in Appendix B. In tables B-1 to B-4, the first two sections show the composition of GDP as either the sum of final demands (with imports negative) and as the sum of value added. The last two columns in each table show the growth rates from 1998 to 2005 and from 2005 to 2010, respectively.

All four scenarios share the characteristic that the GDP growth rate in the first period is higher than that of the second, since the growth of foreign aid and investment is faster in this period. The relative speed of economic growth in the various scenarios can more readily be seen by examining figures B-1 and B-2, which compare the time path of GDP and consumption from 1997 to 2010. The ranking, in terms of growth is: 1) Quick; 2) Painful; 3) Sheltered; and 4) Bulgarian. Recall that the Quick and Painful Adjustment scenarios are those with the rapid liberalization, or higher TFP growth assumption. It is interesting in these simulations that the changes in this assumption dominate changes in the amount of aid given, in the determination of GDP growth. The North Korean economy grows faster in the Painful scenario than in the Sheltered Transition scenario. Note that this is largely a factor of the response of imports. Compare the path of import growth between the Painful Adjustment and the Quick scenarios, which both have the more rapid TFP growth. Although growth is higher in the Quick scenario, there are also much higher imports, since the larger amount of financial aid creates demand for goods which cannot be produced domestically. By 2010, imports in the Quick scenario are $61.9 billion, compared to $46.2 billion in the Painful Adjustment scenario.

Recall that by assumption, larger amounts of FDI eventually generate larger exports. Therefore, exports also grow more quickly in the Quick scenario, reaching $16.5 billion by 2010, compared with $14.1 billion in the Sheltered Transition, $10.8 billion in the Painful Adjustment case, and $9.5 billion in the Bulgarian scenario. In summary, imports and exports are both larger in the scenarios with the larger resource transfers.

The section of the tables labeled “Indicators” shows GDP and income per capita, capital-labor and capital-output ratios, and the average rates of return to capital and labor. The highest capital-labor ratio (29.7) and

the highest return to labor ($3690 wages per year) are reached in the Quick scenario, by 2010. The second highest capital-labor ratio is reached in the Sheltered Transition scenario (25.1) but this in this scenario the return to labor is only $2469. The Painful Adjustment scenario does not reach such a high capital-labor ratio (23.3), but return to labor grows to $3075. This is because the Sheltered Transition scenario has higher rates of resource transfer, which leads to higher rates of investment and capital stock. TFP growth, and therefore the marginal product of labor, do not grow as fast in this scenario. The lowest ranking scenario, both in terms of capital-labor ratio (19.3) and return to labor ($2020) is the Bulgarian case.

Table 5 shows a comparison of the output growth rates of each industry over the simulation interval. The ranking of growth rates is the same for all industries as for the GDP growth rate ranking. This is largely a result of the extreme differences in growth rates between the simulations, and also due to the fact that industry investment, consumption and government consumption were allocated to industry based on fixed shares. However, the variation of growth rates is higher in Commerce and services, which is a large component of personal consumption as well as government consumption. The fastest growing industries in every scenario are Light industry and Other manufactures.

Table 6. Comparison of Average Output Growth Rates by Industry: 1998 - 2010

	Bulgarian	*Sheltered*	*Painful*	*Quick*
1 Agriculture, fisheries and forestry	11.7	13.1	14.6	15.9
2 Mining	9.0	10.0	11.4	12.3
3 Food and beverages	9.6	10.5	12.2	13.0
4 Light industry	12.5	13.7	15.3	16.3
5 Chemicals and petroleum products	10.0	11.0	12.6	13.5
6 Primary metals	9.2	10.1	11.5	12.3
7 Metal products and machinery	9.8	10.9	12.5	13.5
8 Other manufactures	12.7	13.9	15.4	16.5
9 Utilities	11.2	12.6	14.0	15.3
10 Construction, transportation and communication	10.4	10.9	12.7	12.9
11 Commerce and services	4.3	5.6	7.5	8.9

Conclusions and Further Issues

This study has examined four possible scenarios of the impacts on the North Korean economy of Korean unification. We have assumed a situation quite unlike the German case, in the sense that we still treat the two parts of Korea as separate economic entities, with different wage rates, restricted mobility of population, and management of the North Korean economy by the South Korean government, with a gradual transition to a free-market economy. To simplify modeling with our existing data set, we have not assumed any drastic changes in the structure of the economy with respect to investments and subsidies by the government. The four scenarios outlined here vary along two dimensions: 1) size of resource transfer; and 2) speed of liberalization,

modeled as growth of TFP. Our finding is that in the long-run, TFP growth will have more significant contributions to GDP growth and income per capita than aid, although aid is helpful in generating internal investment.

Although the growth rates of GDP (8% to 12%) found in these scenarios may seem high, they are still based on rather conservative assumptions about TFP growth. A rough calculation suggests that, in order to reach parity with South Korea, North Korean GDP would have to grow at an average annual rate of 25% from 1998 to 2010! It is true that there are many reasons to believe that the Koreas will not suffer from many of the problems of the German case. However, it seems realistic to expect that it may require 25 years or more before the North Korean standard of living is on a par with that of the South.

There are several areas in which this study could be improved by further research, and there are a number of aspects of the effect of unification which have not been explicitly treated here. The most obvious improvement for the model builder is the need for better data. Our estimates of GDP are accurate to within perhaps 30%, judging from the dispersion of estimates I have seen. However, the extent of defense production, and of non-defense economic activities by military personnel is unknown. Information on the relative sizes of industries is based on semi-informed judgement.

We have not explicitly assumed any sectoral shifts in economic activity, except what is implied by the distribution of the various components of final demand. However, there is good reason to believe that in a unified Korea, the agricultural sector in North Korea would shrink, as agriculture is relatively inefficient there. The mining and resource extraction sectors would probably grow in relative size. The labor force of North Korea is highly literate, and there seems to be a significant pool of skilled industrial workers. One would expect that in a freer economy, more of this labor would be diverted to the production of consumer goods, and away from heavy industry and defense. In regard to defense activity, we have also not explicitly modeled the benefits accruing from the reduction of defense spending, although they would likely be huge. Some estimates have placed the defense share of GDP as high as 30%, and it appears that high defense spending has been one of the heavy burdens on the economy in the 1980s and early 1990s. We have implicitly assumed that one of the factors responsible for faster TFP growth would be the reduction of defense production, but perhaps our assumptions about the benefits of this reduction are too conservative.

Finally, we have made no explicit assumptions about changes in the direction of trade, and of the gains from trade to North Korea. Noland has made some calculations using the CANSIM trade database and a simple gravity model, both to determine sectors of comparative advantage as well as likely trading partners. Not surprisingly, he estimated that those countries with the highest likely trade shares would be South Korea, Japan, and then China. Sectors of comparative advantage were at a greater level of detail than the model presented here, but include seafood, minerals extraction and light industry. The overall gains to trade to North Korea could be huge, with the change from being a relatively autarkic economy, to becoming an integrated member of the world trading system.

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Appendix A - Data

This appendix shows some of the dataset used in the model in more detail than the main text. Table A-1 below presents the estimated 11 by 11 I-O table estimated in millions of dollars for 1990. This includes intermediate flows, value added and output by industry. The input-output table below was derived by starting with a table for China, scaling final demand vectors to estimated control totals for North Korea, and then rebalancing the table. This table and all other results are presented in equivalent 1990 constant dollars.

Table A-1. Intermediate flows, value added and output for North Korea: 1990

	1	2	3	4	5	6	7	8	9	10	11
1 Agriculture, Forestry and Fisheries	1071.1	13.6	835.6	232.3	77.5	19.6	109.3	105.4	6.3	573.5	291.8
2 Mining	69.2	41.6	13.0	35.1	109.9	191.1	99.2	173.9	250.8	115.6	72.4
3 Food & Beverages	45.3	0.4	80.5	15.0	38.3	1.1	8.9	5.6	.	8.2	513.4
4 Light Industry	219.9	2.9	14.3	670.3	37.8	4.4	103.8	35.4	1.0	55.7	214.1
5 Chemicals & Petroleum Products	324.8	6.2	5.9	52.2	337.8	14.7	213.4	52.6	30.5	247.9	282.2
6 Primary Metals	36.7	7.4	0.9	4.9	18.4	275.9	569.1	19.6	2.2	296.6	6.8
7 Metal Products and Machinery	93.7	16.5	5.8	6.0	19.0	47.0	386.2	29.6	10.7	388.5	186.6
8 Other Manufatures	48.1	7.6	4.2	8.1	22.6	26.6	90.4	42.0	0.3	740.2	79.5
9 Utilities	17.2	14.6	3.5	17.8	52.7	63.3	55.8	54.2	.	36.8	41.4
10 Construction, Transportation and Communication	32.8	3.2	19.4	11.0	25.5	37.5	43.2	30.0	14.4	144.8	60.1
11 Commerce & Services	72.6	2.5	10.0	40.2	54.4	17.3	57.8	7.5	11.3	82.9	125.4
Total Intermediate	2031.4	116.5	993.1	1092.9	793.9	698.5	1737.1	555.8	327.5	2690.7	1873.7
Value Added	5362.9	778.7	1316.9	1522.7	1193.6	712.2	2670.8	615.9	250.0	3940.7	4796.8
Output	7394.3	895.2	2310.0	2615.6	1987.5	1410.7	4407.9	1171.7	577.5	6631.4	6670.5

TABLE A-2. Macroeconomic Variables for Selected Historical Years

	1980	*1985*	*1987*	*1990*	*1992*	*1994*
GDP by Expenditure Category						
Personal consumption	4092	6615	8985	11015	4465	3962
Government consumption	3589	2619	3032	3393	6932	7323
Investment	6256	6460	8387	9484	10437	10448
	1431	1202		1853	936	
Imports	1835		2466	2584		1253
GDP - Sum of final demands	13534	15140	19451	23161	21152	21251
GDP by value added						
Total capital return	11097	11197	14096	16595	18495	18894
Total labor return	2439	3943	5356	6566	2661	2362
GDP - Sum of value added	13536	15140	19452	23161	21156	21256
EMPLOYMENT AND POPULATION						
Thousands of persons						
Labor force = employment	7005	8339	8868	9652	10430	10369
Population	18170	19995	20685	21720	22336	22953
SAVINGS AND INVESTMENT						
Government saving	5855	5906	7434	8753	9759	9970
Foreign saving	403	554	952	731	682	482
Total investment	6258	6459	8386	9484	10441	10452
Total capital stock	137534	136024	141693	150682	159053	167149
GOVERNMENT DISBURSEMENTS						
Government consumption	3589	2619	3032	3393	6932	7323
Subsidies to households	1653	2673	3630	4449	1804	1601
Government savings	5855	5906	7434	8753	9759	9970
= Total disbursements	11097	11197	14096	16595	18495	18894
HOUSEHOLDS						
Total wage income	2439	3943	5356	6566	2661	2362
Subsidies	1653	2673	3630	4449	1804	1601
= Household income	4092	6616	8986	11015	4465	3962
INDICATORS						
GDP per capita (thousands)	0.74	0.76	0.94	1.07	0.95	0.93
Household income per capita	0.23	0.33	0.43	0.51	0.20	0.17
Capital-labor ratio	19.63	16.31	15.98	15.61	15.25	16.12
Capital-output ratio	10.16	8.98	7.28	6.51	7.52	7.86
Average rate of return to capital	0.08	0.08	0.10	0.11	0.12	0.11
Average rate of return to labor	0.35	0.47	0.60	0.68	0.26	0.23

Appendix B - Scenario Results

This appendix contains the summary tables and graphs for the four simulations. Tables B-1 to B-4 are the summary tables, and Figures B-1 to B-9 are comparison graphs for GDP, consumption, investment, exports, imports, GDP per capita, income per capita, return to capital, and return to labor, respectively.

Figure 5 in the text is reproduced below for reference.

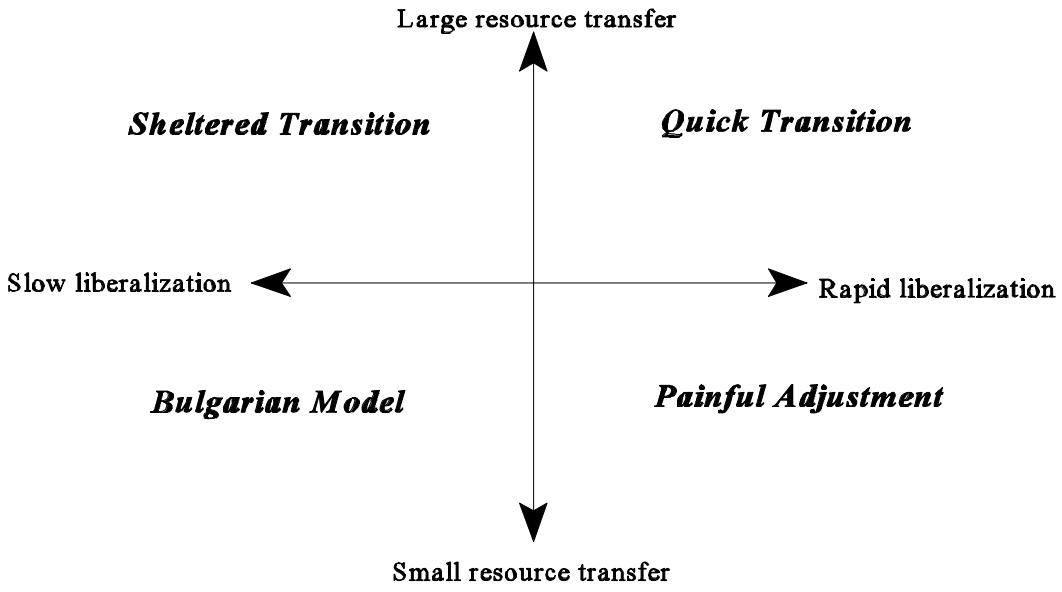


Table B-1. Summary Results for Bulgarian Scenario

	1998	*2000*	*2002*	*2005*	*2010*	*98-05*	*05-10*
SUMMARY OF GDP BY FINAL DEMAND CATEGORY							
Personal consumption	9128.2	11726.4	15944.1	25365.7	47204.0	14.6	12.4
Government consumption	10724.0	8653.9	8819.1	10066.4	8978.4	-0.9	-2.3
Investment	10357.2	16450.7	20263.9	25262.5	37082.6	12.7	7.7
Exports	2270.5	2635.1	3861.2	6503.6	9464.8	15.0	7.5
Imports	9041.7	12360.4	15942.9	22518.3	34709.6	13.0	8.7
GDP - Sum of final demands	23438.3	27105.8	32945.3	44679.9	68020.2	9.2	8.4
GDP BY VALUE ADDED							
Total capital return	17942.7	20048.0	23355.4	29428.3	39637.6	7.1	6.0
Total labor return	5476.9	7035.9	9566.4	15219.4	28322.4	14.6	12.4
GDP - Sum of value added	23419.6	27083.9	32921.8	44647.7	67960.0	9.2	8.4
EMPLOYMENT AND POPULATION (in thousands of persons)							
Labor force = employment	11824	12083	12443	12982	14022	1.3	1.5
Military forces	200	200	200	200	200	0.0	0.0
Migrated to ROK (cumulative)	25	100	100	100	100	19.8	0.0
Population	24839	25515	26325	27539	29880	1.5	1.6
SAVINGS AND INVESTMENT							
Government saving	19509.3	25595.2	27644.5	26820.3	26493.8	4.5	-0.2
Foreign saving	6771.2	9725.3	12081.7	16014.7	25244.7	12.3	9.1
Total investment	10357.2	16450.7	20263.9	25262.5	37082.6	12.7	7.7
Total capital stock	111276.2	117852.1	137206.7	177125.4	270494.3	6.6	8.5
GOVERNMENT RECEIPTS AND DISBURSEMENTS							
Government earnings	17942.7	20048.0	23355.4	29428.3	39637.6	7.1	6.0
Foreign aid receipts	13653.1	12923.9	12111.8	10942.6	9147.2	-3.2	-3.6
Foreign direct investment	2288.9	5967.8	7374.0	6662.1	5569.0	15.3	-3.6
= Total revenue	33884.6	38939.7	42841.2	47033.0	54353.8	4.7	2.9
Government consumption	10724.0	8653.9	8819.1	10066.4	8978.4	-0.9	-2.3
Subsidies to households	3651.3	4690.6	6377.6	10146.3	18881.6	14.6	12.4
Government savings	19509.3	25595.2	27644.5	26820.3	26493.8	4.5	-0.2
= Total disbursements	33884.6	38939.7	42841.2	47033.0	54353.8	4.7	2.9
Government savings rate	0.58	0.66	0.65	0.57	0.49	-0.1	-3.1
HOUSEHOLDS							
Total wage income	5476.9	7035.9	9566.4	15219.4	28322.4	14.6	12.4
Subsidies	3651.3	4690.6	6377.6	10146.3	18881.6	14.6	12.4
= Household income	9128.2	11726.4	15944.1	25365.7	47204.0	14.6	12.4
INDICATORS							
GDP per capita (thousands)	0.944	1.062	1.251	1.622	2.276	7.7	6.8
Household income per capita	0.367	0.460	0.606	0.921	1.580	13.1	10.8
Capital-labor ratio	9.411	9.754	11.027	13.644	19.291	5.3	6.9
Capital-output ratio	4.748	4.348	4.165	3.964	3.977	-2.6	0.1
Average rate of return to capital	0.161	0.178	0.185	0.181	0.159	1.7	-2.6
Average rate of return to labor	0.463	0.582	0.769	1.172	2.020	13.3	10.9

Table B-2. Summary Results for Sheltered Transition Scenario

	1998	*2000*	*2002*	*2005*	*2010*	*98-05*	*05-10*
SUMMARY OF GDP BY FINAL DEMAND CATEGORY							
Personal consumption	9128.2	11990.6	17528.2	30316.3	57706.9	17.1	12.9
Government consumption	9341.5	5541.4	5686.7	7972.7	6935.9	-2.3	-2.8
Investment	12887.1	22646.5	28395.4	34430.9	47912.8	14.0	6.6
Exports	2270.5	2864.2	5113.0	9690.2	14046.7	20.7	7.4
Imports	10189.5	15490.1	21405.5	31472.8	47654.1	16.1	8.3
GDP - Sum of final demands	23437.7	27552.6	35317.8	50937.4	78948.1	11.1	8.8
GDP BY VALUE ADDED							
Total capital return	17942.7	20338.1	24780.9	32717.1	44257.2	8.6	6.0
Total labor return	5476.9	7194.4	10516.9	18189.8	34624.1	17.1	12.9
GDP - Sum of value added	23419.6	27532.5	35297.8	50906.9	78881.4	11.1	8.8
EMPLOYMENT AND POPULATION (in thousands of persons)							
Labor force = employment	11824	12083	12443	12982	14022	1.3	1.5
Military forces	200	200	200	200	200	0.0	0.0
Migrated to ROK (cumulative)	25	100	100	100	100	19.8	0.0
Population	24839	25515	26325	27539	29880	1.5	1.6
SAVINGS AND INVESTMENT							
Government saving	49121.6	59415.3	61955.1	57675.6	51903.5	2.3	-2.1
Foreign saving	7919.0	12625.9	16292.5	21782.6	33607.4	14.5	8.7
Total investment	12887.1	22646.5	28395.4	34430.9	47912.8	14.0	6.6
Total capital stock	111276.2	124800.9	158139.0	221104.1	351733.3	9.8	9.3
GOVERNMENT RECEIPTS AND DISBURSEMENTS							
Government earnings	17942.7	20338.1	24780.9	32717.1	44257.2	8.6	6.0
Foreign aid receipts	39353.0	37251.1	34910.6	31540.4	26365.4	-3.2	-3.6
Foreign direct investment	4818.7	12163.6	14961.7	13517.3	11299.5	14.7	-3.6
= Total revenue	62114.4	69752.9	74653.1	77774.8	81922.1	3.2	1.0
Government consumption	9341.5	5541.4	5686.7	7972.7	6935.9	-2.3	-2.8
Subsidies to households	3651.3	4796.3	7011.3	12126.5	23082.7	17.1	12.9
Government savings	49121.6	59415.3	61955.1	57675.6	51903.5	2.3	-2.1
= Total disbursements	62114.4	69752.9	74653.1	77774.8	81922.1	3.2	1.0
Government savings rate	0.79	0.85	0.83	0.74	0.63	-0.9	-3.1
HOUSEHOLDS							
Total wage income	5476.9	7194.4	10516.9	18189.8	34624.1	17.1	12.9
Subsidies	3651.3	4796.3	7011.3	12126.5	23082.7	17.1	12.9
= Household income	9128.2	11990.6	17528.2	30316.3	57706.9	17.1	12.9
INDICATORS							
GDP per capita (thousands)	0.944	1.080	1.850	2.334	2.642	9.6	7.1
Household income per capita	0.367	0.470	1.101	1.589	1.931	15.7	11.2
Capital-labor ratio	9.411	10.329	17.032	21.713	25.084	8.5	7.7
Capital-output ratio	4.748	4.530	4.341	4.373	4.455	-1.3	0.5
Average rate of return to capital	0.161	0.177	0.164	0.148	0.137	0.3	-3.6
Average rate of return to labor	0.463	0.595	1.401	2.028	2.469	15.8	11.3

Table B-3. Summary Results for Painful Adjustment Scenario

	1998	*2000*	*2002*	*2005*	*2010*	*98-05*	*05-10*
SUMMARY OF GDP BY FINAL DEMAND CATEGORY							
Personal consumption	9128.2	12940.6	18810.0	32578.4	68281.8	18.2	14.8
Government consumption	10724.0	9924.1	11006.5	13472.6	13375.1	3.3	-0.1
Investment	10357.2	17007.3	21972.5	29513.0	48785.5	15.0	10.1
Exports	2270.5	2654.7	4060.2	7254.4	10791.1	16.6	7.9
Imports	9041.7	12821.0	17412.5	26660.4	46165.5	15.4	11.0
GDP - Sum of final demands	23438.3	29705.8	38436.8	56158.1	95067.9	12.5	10.5
GDP BY VALUE ADDED							
Total capital return	17942.7	21921.6	27127.9	36577.0	54025.7	10.2	7.8
Total labor return	5476.9	7764.4	11286.0	19547.0	40969.1	18.2	14.8
GDP - Sum of value added	23419.6	29686.0	38413.9	56124.0	94994.8	12.5	10.5
EMPLOYMENT AND POPULATION (in thousands of persons)							
Labor force = employment	11824	11783	11983	12282	13322	0.5	1.6
Military forces	200	200	200	200	200	0.0	0.0
Migrated to ROK (cumulative)	25	400	560	800	800	49.5	0.0
Population	24839	25215	25865	26839	29180	1.1	1.7
SAVINGS AND INVESTMENT							
Government saving	19509.3	25712.8	28083.2	27677.7	28054.1	5.0	0.3
Foreign saving	6771.2	10166.3	13352.3	19406.0	35374.5	15.0	12.0
Total investment	10357.2	17007.3	21972.5	29513.0	48785.5	15.0	10.1
Total capital stock	111276.2	117852.1	138868.3	186037.2	310971.9	7.3	10.3
GOVERNMENT RECEIPTS AND DISBURSEMENTS							
Government earnings	17942.7	21921.6	27127.9	36577.0	54025.7	10.2	7.8
Foreign aid receipts	13653.1	12923.9	12111.8	10942.6	9147.2	-3.2	-3.6
Foreign direct investment	2288.9	5967.8	7374.0	6662.1	5569.0	15.3	-3.6
= Total revenue	33884.6	40813.2	46613.7	54181.7	68741.9	6.7	4.8
Government consumption	10724.0	9924.1	11006.5	13472.6	13375.1	3.3	-0.1
Subsidies to households	3651.3	5176.3	7524.0	13031.4	27312.7	18.2	14.8
Government savings	19509.3	25712.8	28083.2	27677.7	28054.1	5.0	0.3
= Total disbursements	33884.6	40813.2	46613.7	54181.7	68741.9	6.7	4.8
Government savings rate	0.58	0.63	0.60	0.51	0.41	-1.7	-4.5
HOUSEHOLDS							
Total wage income	5476.9	7764.4	11286.0	19547.0	40969.1	18.2	14.8
Subsidies	3651.3	5176.3	7524.0	13031.4	27312.7	18.2	14.8
= Household income	9128.2	12940.6	18810.0	32578.4	68281.8	18.2	14.8
INDICATORS							
GDP per capita (thousands)	0.944	1.178	1.486	2.092	3.258	11.4	8.9
Household income per capita	0.367	0.513	0.727	1.214	2.340	17.1	13.1
Capital-labor ratio	9.411	10.002	11.589	15.147	23.343	6.8	8.6
Capital-output ratio	4.748	3.967	3.613	3.313	3.271	-5.1	-0.3
Average rate of return to capital	0.161	0.195	0.214	0.217	0.193	4.3	-2.4
Average rate of return to labor	0.463	0.659	0.942	1.592	3.075	17.6	13.2

Table B-4. Summary Results for Quick Transition Scenario

	1998	*2000*	*2002*	*2005*	*2010*	*98-05*	*05-10*
SUMMARY OF GDP BY FINAL DEMAND CATEGORY							
Personal consumption	9128.2	13231.5	20640.3	38651.8	81937.7	20.6	15.0
Government consumption	9341.5	6834.4	7873.6	11680.6	11439.8	3.2	-0.4
Investment	12887.1	23203.1	30057.5	39063.5	60900.0	15.8	8.9
Exports	2270.5	2905.3	5493.0	11118.9	16494.2	22.7	7.9
Imports	10189.5	15979.8	23135.4	36836.3	61939.7	18.4	10.4
GDP - Sum of final demands	23437.7	30194.4	40928.9	63678.4	108831.9	14.3	10.7
GDP BY VALUE ADDED							
Total capital return	17942.7	22237.6	28526.3	40456.3	59589.0	11.6	7.7
Total labor return	5476.9	7938.9	12384.2	23191.1	49162.6	20.6	15.0
GDP - Sum of value added	23419.6	30176.5	40910.5	63647.4	108751.6	14.3	10.7
EMPLOYMENT AND POPULATION (in thousands of persons)							
Labor force = employment	11824	11783	11743	12282	13322	0.5	1.6
Military forces	200	200	200	200	200	0.0	0.0
Migrated to ROK (cumulative)	25	400	800	800	800	49.5	0.0
Population	24839	25215	25625	26839	29180	1.1	1.7
SAVINGS AND INVESTMENT							
Government saving	49121.6	59525.4	62268.8	58372.7	53039.0	2.5	-1.9
Foreign saving	7919.0	13074.6	17642.5	25717.5	45445.6	16.8	11.4
Total investment	12887.1	23203.1	30057.5	39063.5	60900.0	15.8	8.9
Total capital stock	111276.2	124800.9	159818.4	230245.9	396095.6	10.4	10.9
GOVERNMENT RECEIPTS AND DISBURSEMENTS							
Government earnings	17942.7	22237.6	28526.3	40456.3	59589.0	11.6	7.7
Foreign aid receipts	39353.0	37251.1	34910.6	31540.4	26365.4	-3.2	-3.6
Foreign direct investment	4818.7	12163.6	14961.7	13517.3	11299.5	14.7	-3.6
= Total revenue	62114.4	71652.4	78398.5	85514.0	97253.8	4.6	2.6
Government consumption	9341.5	6834.4	7873.6	11680.6	11439.8	3.2	-0.4
Subsidies to households	3651.3	5292.6	8256.1	15460.7	32775.1	20.6	15.0
Government savings	49121.6	59525.4	62268.8	58372.7	53039.0	2.5	-1.9
= Total disbursements	62114.4	71652.4	78398.5	85514.0	97253.8	4.6	2.6
Government savings rate	0.79	0.83	0.79	0.68	0.55	-2.1	-4.5
HOUSEHOLDS							
Total wage income	5476.9	7938.9	12384.2	23191.1	49162.6	20.6	15.0
Subsidies	3651.3	5292.6	8256.1	15460.7	32775.1	20.6	15.0
= Household income	9128.2	13231.5	20640.3	38651.8	81937.7	20.6	15.0
INDICATORS							
GDP per capita (thousands)	0.944	1.197	1.597	2.373	3.730	13.2	9.0
Household income per capita	0.367	0.525	0.805	1.440	2.808	19.5	13.4
Capital-labor ratio	9.411	10.592	13.610	18.747	29.732	9.8	9.2
Capital-output ratio	4.748	4.133	3.905	3.616	3.640	-3.9	0.1
Average rate of return to capital	0.161	0.193	0.204	0.198	0.167	3.0	-3.4
Average rate of return to labor	0.463	0.674	1.055	1.888	3.690	20.1	13.4

Figure B-1

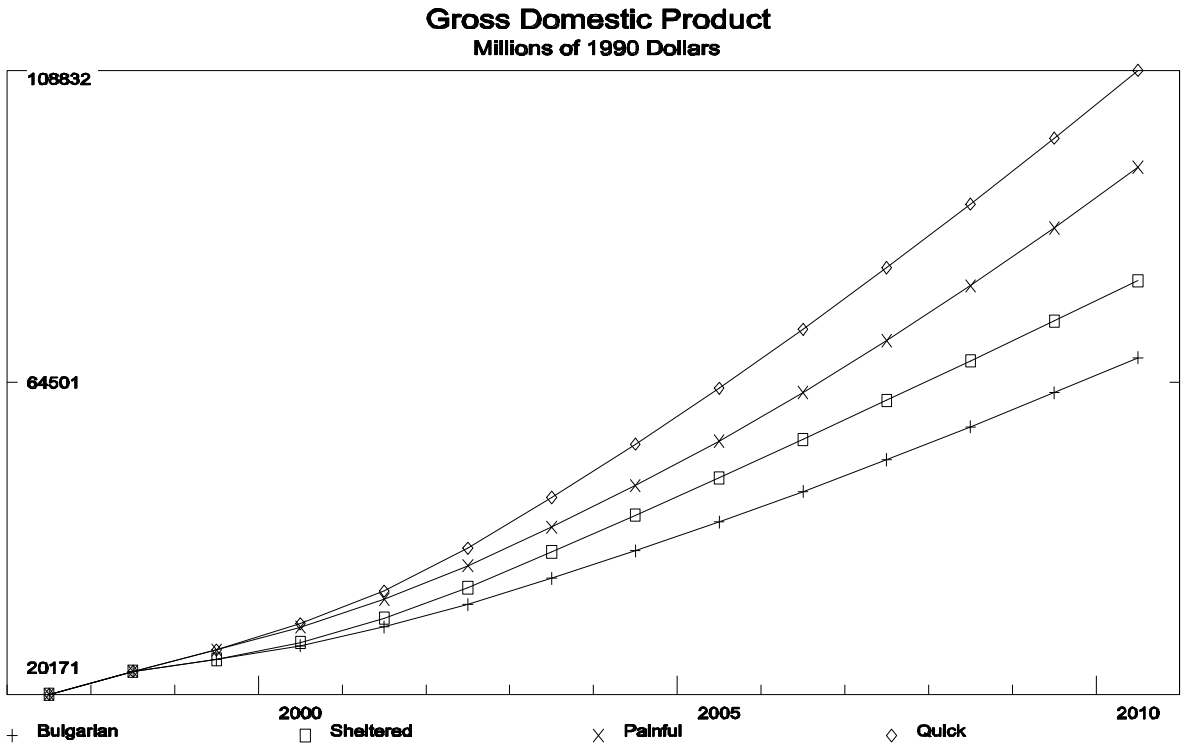


Figure B-2

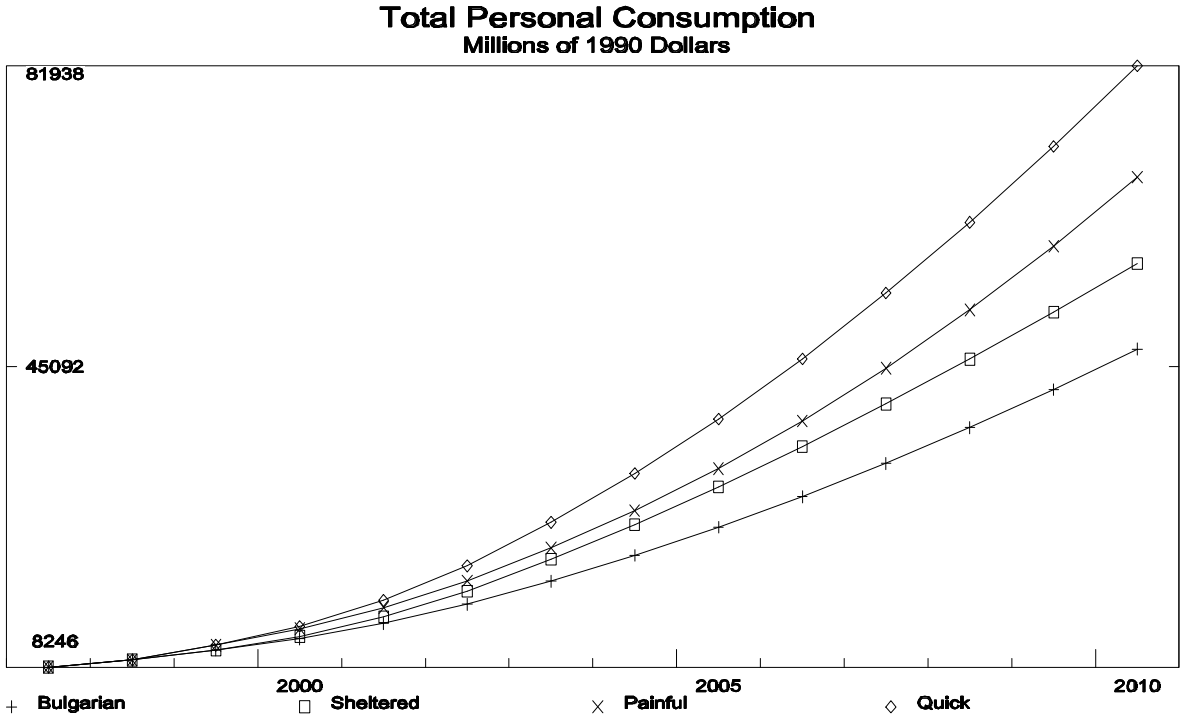


Figure B-3

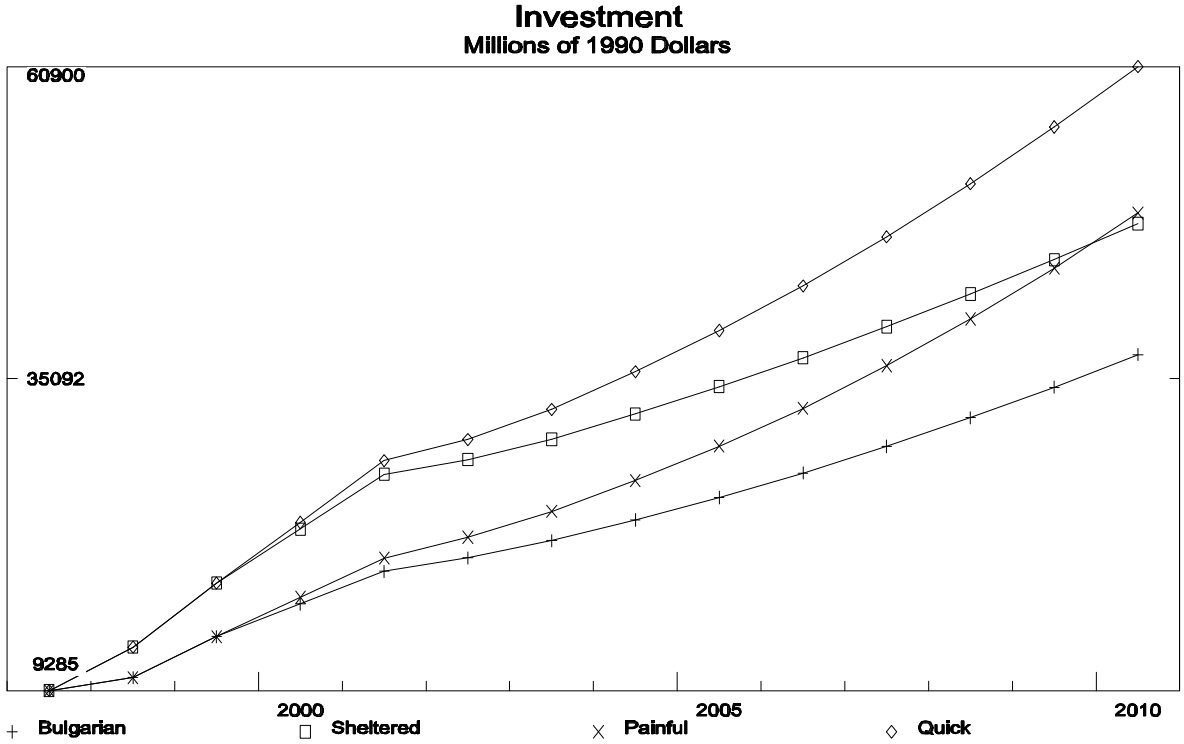


Figure B-4

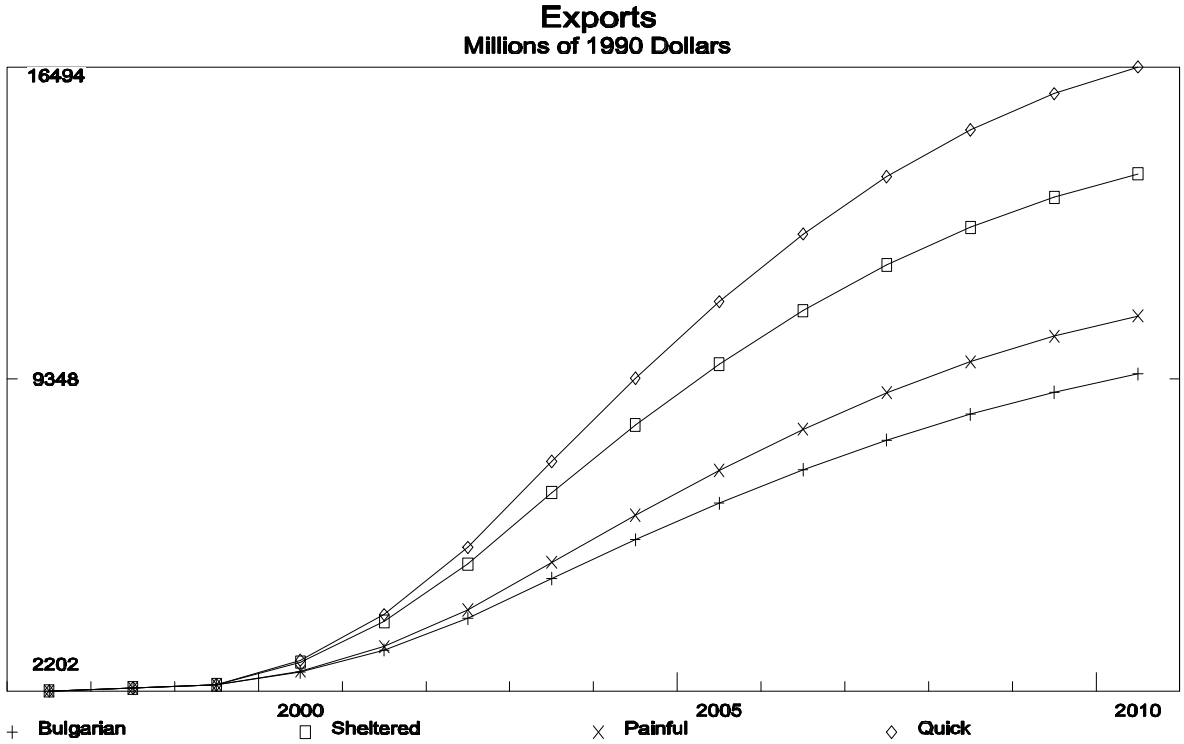


Figure B-5

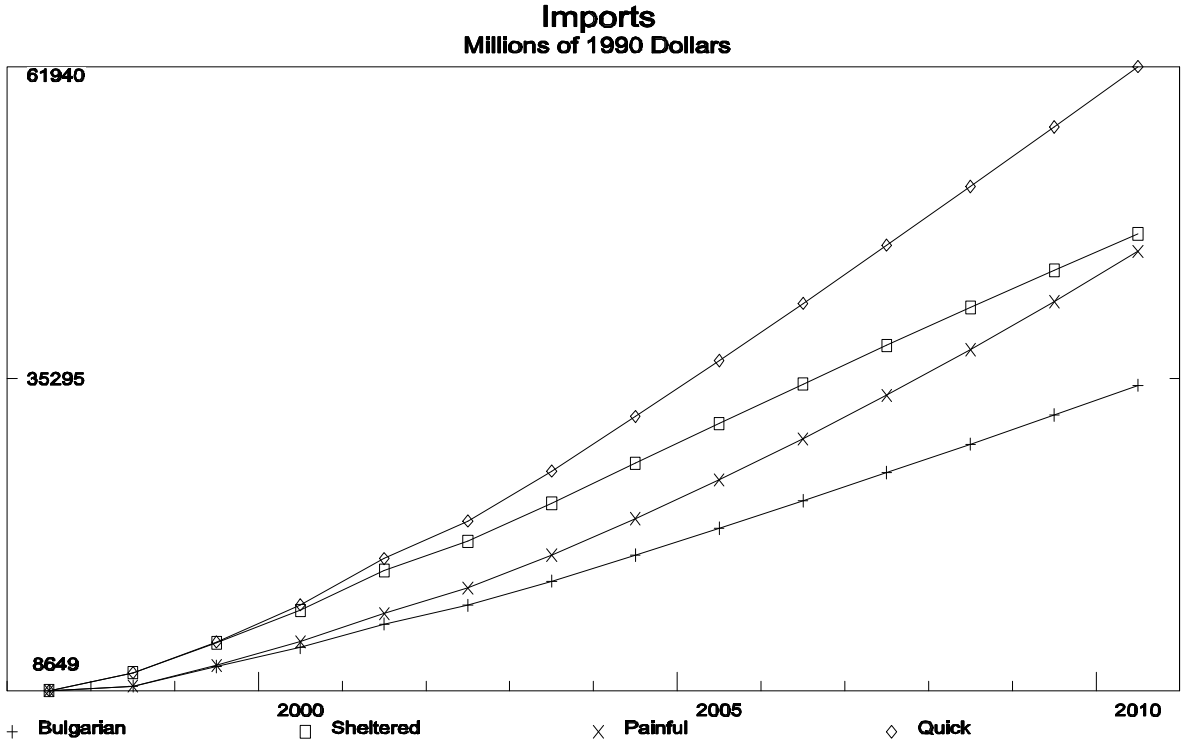


Figure B-6

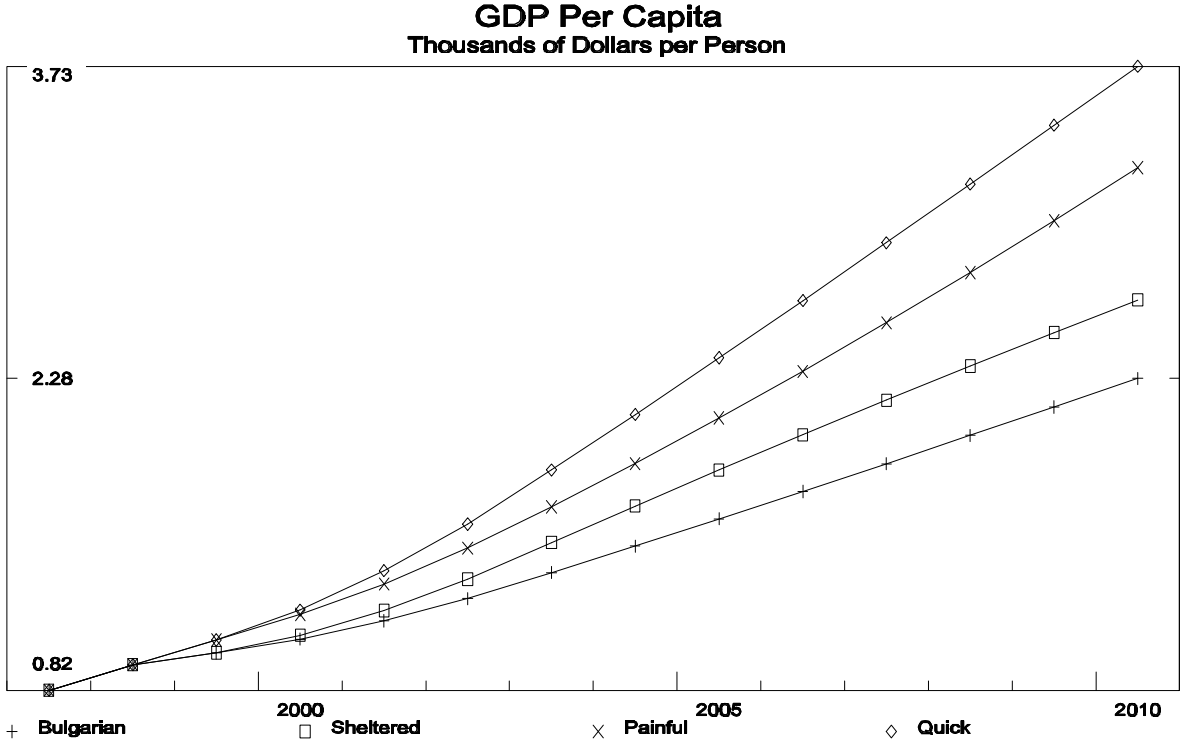


Figure B-7

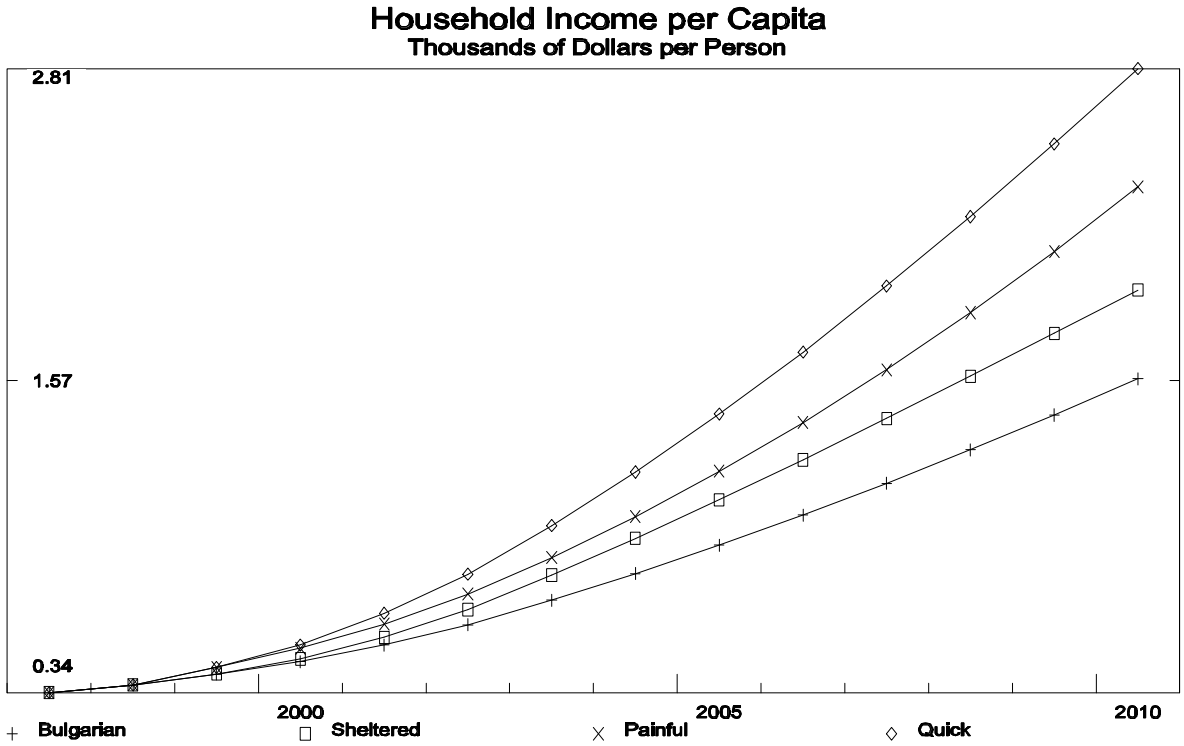


Figure B-8

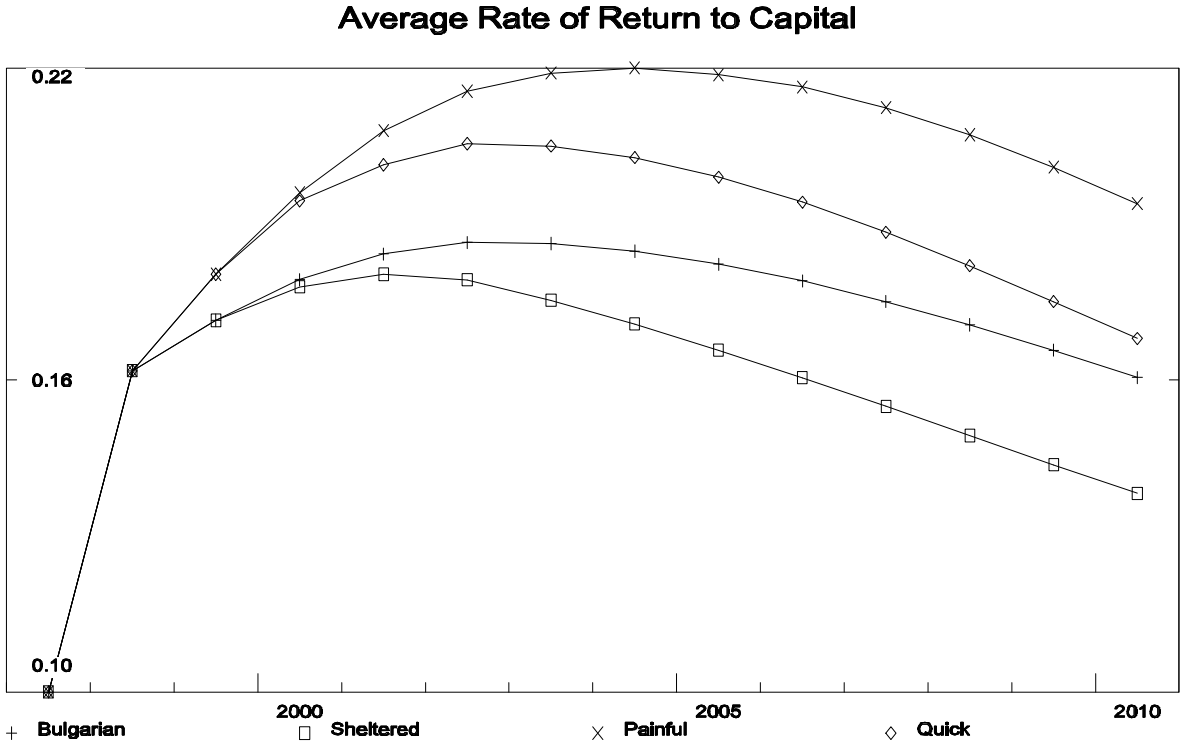
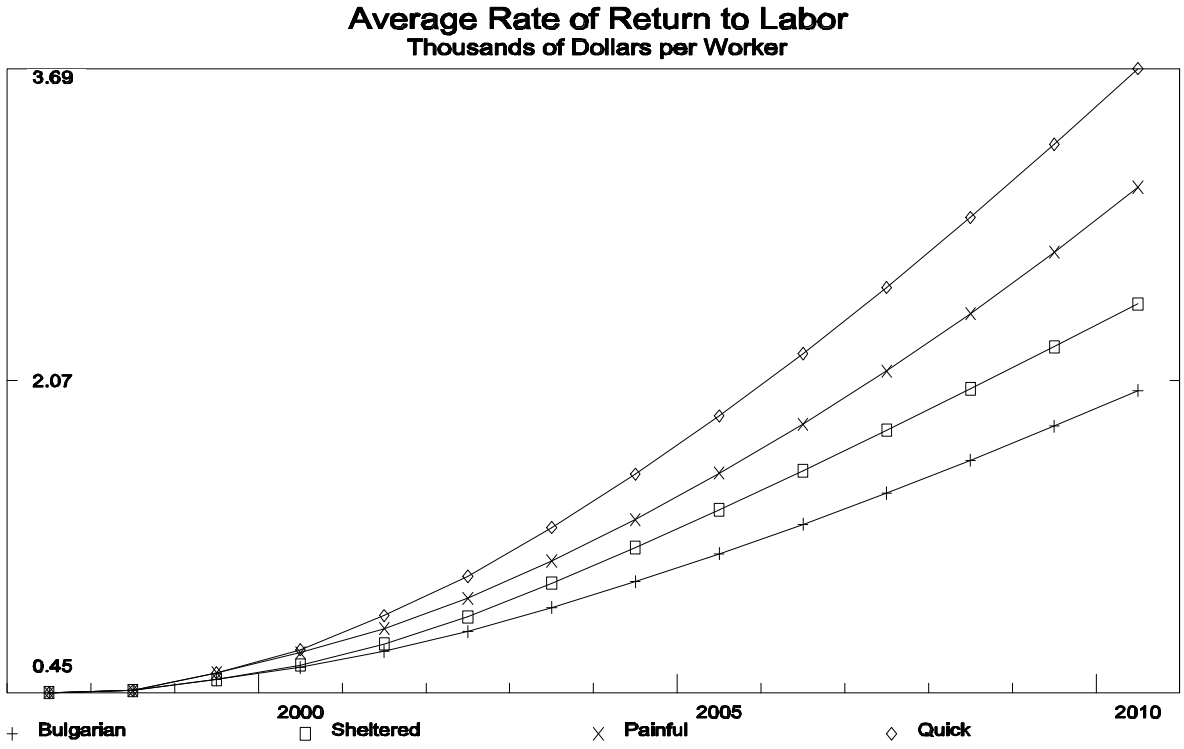


Figure B-9


Average Rate of Return to Labor
Thousands of Dollars per Worker
3.69
2.07
0.45
2000
2005
2010
Bulgarian
Sheltered
Painful
Quick