

# The Former USSR Forest Sector and Capital Constraints

*John Perez-Garcia*  
*and*  
*Charles Backman*

CP-95-1  
March 1995

*Collaborative Papers* report work which has not been performed solely at the International Institute for Applied Systems Analysis and which has received only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work.



International Institute for Applied Systems Analysis □ A-2361 Laxenburg □ Austria

Telephone: +43 2236 807 □ Fax: +43 2236 71313 □ E-Mail: [info@iiasa.ac.at](mailto:info@iiasa.ac.at)



## FOREWORD

This Collaborative Paper has been produced through the efforts of Dr. John Perez-Garcia of the Center for International Trade in Forest Products (CINTRAFOR) located at the University of Washington and Dr. Charles A. Backman of the Siberian Forest Study project located at the International Institute for Applied Systems Analysis (IIASA). Financial support being provided by IIASA and Industry Canada, Drs. Perez-Garcia and Backman pooled their collective experience in order to bring this report to being.

The tool employed in the analysis was the CINTRAFOR Global Trade Model (CGTM) which in an earlier version had been imported from IIASA. CINTRAFOR, relying in part on the CGTM, provides wide ranging research into issues which impact on the trade of forest products. Further information about CINTRAFOR and the CGTM can be obtained by contacting the Director of CINTRAFOR at CINTRAFOR, College of Forest Resources, University of Washington, Seattle, Washington, 98195, USA.

The Siberian Forest Study project is a large multi-disciplinary endeavor encompassing nine key study areas, one of which is the component examining "Forest Industry and Markets". It is under this component which the following report was created. Other components include "Greenhouse Gas Balances", "Forest Resources and Forest Utilization", "Biodiversity, Landscapes, and Bioproductivity", "Non-Wood Products and Functions", "Environmental Status", "Transportation Infrastructure", "Socio-economics", and the "Siberian Study Databases". For further information about the Siberian Forest Study, please contact Sten Nilsson, Project Leader, at IIASA.



## INTRODUCTION

The forest sectors of the republics of the former Soviet Union are at a cross-roads. Political forces are promoting market reforms in a previously highly-distorted domestic economy where costs of production did not balance prices for goods and services. The current, partial transition between non-economic determination of resource allocation to one where markets, through price signals, will allocate productive factors has disrupted the productive capacity of the forest sector. It has now become more difficult for these forest sectors to meet their domestic requirements and international demands. Productive capacity is deteriorating, being underutilized or closing leading to a reduction in capacity.

The deterioration of the former Soviet Union's infrastructure, and the lack of planning, political stability and effective market mechanisms will constrain the participation of the Eastern region of the former USSR--now the Eastern region of Russia--in Pacific Rim wood markets. Similarly, these factors will also limit the ability of the former republics of the western region of the old former Soviet Union, particularly Western Russia, to supply the needs of European markets. Also, Western Russia's ability to supply the other former republics of the Soviet Union is uncertain. As projected demands for timber begin to rise again due to reconstruction efforts and economic stimulus, there will be new strains placed on the productive capacity of the Western and Eastern regions of the Russian republic, where the majority of the productive capacity of the former Soviet Union exists.

The goal of market reforms is to eliminate market distortions. However, the on-going transition period has maintained a higher price for international wood than the domestic wood price within Russia. Although there has been growth in the cost to obtain wood, it is not directly limited to higher costs for harvesting timber. Rather, the growth in the price to purchase wood is due to added costs that reflect the lack of information on the part of the seller and market control on the part of the buyer. The low domestic prices paid for forest sector goods can not provide the returns for much needed capital infusion to replace the deteriorating capital stock in the country. Yet opening its resource base to international markets will likely deprive the domestic sector of low-cost building supplies required to meet domestic demands. At present, export controls will likely maintain a price wedge between international and domestic prices in place.

The price wedge will also make it unprofitable for international investments to service domestic markets if the acquisition value reflects the revenue stream in the international market. Any investments in the forest sector, particularly from international sources, will presumably focus productive resources towards servicing the higher-priced international markets. This would be particularly true since market reforms should eliminate any previous subsidy associated with investments in Russia.

These factors will shape the development of the forest sectors in the former Soviet Union republics in the near future. They also make the process of providing projections for the Russian forest sector an interesting analytical challenge. Many factors, including lack of information and the degree of market control, are not addressed here. The study presents an analysis of the likely capital constraints that Russia and other republics of the former Soviet Union will face under evolving competitive market conditions. As such it serves as

a first step in determining the future of forestry in the former Soviet republics, particularly Russia.

## STUDY OBJECTIVES AND IMPORTANCE

The objectives of the study are to identify likely competitive price responses in the former Soviet Union market for roundwood, the likely impacts of different levels of roundwood exports on international prices and the feedback of international prices may have on the domestic price. The study postulates that, without adequate levels of investments in harvesting and processing capacity, domestic demand--with below international market prices--will further erode the existing capital base. As a consequence capital constraints will lead to serious shortages in wood supply in the near future in the absence of capital investment. A more rapid approach to market prices would force serious inflationary pressures on domestic demand.

The result of the study may be used to determine possible policy strategies needed to forestall a decline in output in the forest sector. A collapse of the forest sector will lead to serious wood shortages in meeting the domestic demands of former Soviet republics and may lead to a deterioration in the environment. Lower returns to the sector will limit forest management activities. The forest sector may also miss the opportunity to raise foreign exchange in international markets.

## STUDY ORGANIZATION

The remainder of the report is divided into 5 sections. The following section develops the logic of the study. It provides information on changes expected to occur within the forest sectors of the republics of the former Soviet Union. Section 2 describes the study approach. The section outlines the modeling assumptions employed and how results will define the importance of capital constraints. Section 3 defines the scenarios chosen to examine the impact of assumptions and policy changes. A fourth section presents the results of the study. Section 5 follows with a discussion of the implications of the study results. The discussion evolves around three areas: (1) domestic implications; (2) international effects; and (3) feedback of the international effects on the domestic sector. A final section offers conclusions of the study and a discussion of potential policy alternatives facing the republics, particularly Russia and international communities.

## CAPACITY CONSTRAINTS WILL DETERMINE HARVEST LEVELS

A limiting factor in expanding log production in the former USSR is the condition and extent of its existing capital stock (Backman and Waggener 1994). The condition of harvesting capacity, processing capital and infrastructure is becoming more important as investment in the forest sector seriously lags the depletion of the capital stock. The reduction in demand and the lack of market mechanisms to maintain profitable operations even for international markets are key elements affecting the future of these forest sectors.

A decline in harvest capacity will constrain future harvest flows in the former USSR forest sector. Without investments in maintenance and replacement, the capital stock will become inoperable and obsolete preventing any expansion in harvest flows to occur. Under these conditions, harvest flows will be defined principally by the remaining, operable capacity to produce roundwood and processed wood products. Utilization of the existing capital stock is greater in the Western reaches of the former Soviet Union due to the concentration of demand and closer proximity of productive capacity. Hence, the deterioration of the capital stock will reduce log production, first in the Western region of the former USSR, where demand is strongest, followed by a decline in log production in the Eastern region. A similar outlook--declining capacity brought on by the passage of time and use--is expected for log processing capacity and other infrastructure used by the forest sector.

The Eastern region of former USSR--now Eastern Russia--acts as a marginal producer to supply the consumption needs of the much larger Western domestic market. In addition, the Eastern region will respond to international demands, but only to a small extent. Export licenses and inadequate infrastructure will control the amount of export logs--the principal export commodity--to international markets. A continuation of low, distorted rail rates will allow products to be shipped from the Eastern to Western Russia. The under-utilized harvesting capacity in the East will provide a temporary source of additional capacity when capital constraints in the West begin to reduce their production and prices rise sufficiently to account for the transfer costs of moving forest products. The supply of processed products from the East will continue until its processing capacity becomes a limiting factor of production or transfer costs become prohibitive.

## STUDY APPROACH

The study's major task is to determine a potential range of harvest outlooks for the former Soviet Union and draw inferences for the Russian republic in particular. The study utilizes the CINTRAFOR Global Trade Model (CGTM) to accomplish the task.<sup>1</sup> The global model provides a framework to examine how domestic markets within the former USSR behave and how the domestic markets may respond to international demand. Since the interaction of the former USSR's forest sector is primarily isolated from external markets, the study evaluates the linkage to international markets using different scenarios of exports from former USSR to non-former Soviet Union markets.<sup>2</sup> Scenario analysis is also used to illustrate the impacts of varying assumptions on demand, transportation costs and capital investments.

In CGTM, the former Soviet Union is divided into two regions: Western and Eastern former USSR. CGTM data for Western Soviet Union includes aggregate information on the European republics, European Russian, Central Asian republics and West Siberia. Isolation of the European Russian region and West Siberia--the Western Russian region--from the CGTM-defined former Soviet Union West region was not attempted in the study.

---

<sup>1</sup> A full treatment of the CGTM can be found in Cardellichio *et al.* (1988, 1989). See also Kallio, Dykstra and Binkley (1987).

<sup>2</sup> Non-former Soviet Union markets exclude the former Soviet European and Asian republics.

However, when analyzing demand sensitivity, recent data used to describe the former Soviet Union West region is adjusted where appropriate to reflect Western Russian conditions (i.e. excluding the European and Asian republics). In following this approach we assume that most of the productive capacity of the former USSR West region is located in Western Russia, and the breakup of the former USSR has resulted in reduced trade between Western Russia and the European and Asian republics of the former USSR. CGTM-defined Eastern former Soviet Union includes East Siberia and Far East regions of the Russian republic. This regional definition corresponds to the present political definition of Eastern Russia.

Log supply in CGTM for the two former USSR regions is defined using point estimates for 1992. Log prices for 1992 correspond to the level of harvesting capacity employed for that year. An estimate was made to determine how much a price increase would be required to employ 100 percent of the harvest capacity. The two price estimates, based on the percentage of harvesting capacity employed in the two Russian regions, define supply elasticities which are incorporated into the model's timber supply section. The coniferous elasticity estimates are 0.5 and 1.0 for the Western and Eastern regions respectively. The deciduous elasticity estimate are 0.5 and 0.7 for the Western and Eastern regions respectively.

In CGTM, product supply is characterized by a short-run cost curve where capital is fixed in the short term, but allowed to adjust over time. The product supply model considers changes in log costs, but maintains other variable costs constant in real terms over time. A product supply curve is constructed to characterize the utilization of existing production capacity in each of the two former USSR regions. Information on variable production costs were taken from Backman and Waggener (1994). Supply elasticities are assumed to correspond to the average price response observed for other regions in the model. The estimated elasticities used in the study are 0.2 for the two CGTM USSR regions.

Projecting harvesting and processing capital over time is a critical component of the study. In CGTM, constraining the growth of processing capacity of lumber mills is a straightforward procedure and is implemented in the capacity updating routine.<sup>3</sup> Capacity expansion (contraction) is based on historical profitability and usage. It will expand (contract) when historical profitability is positive (negative). The rate at which capacity expands or contracts is determined by user-specified bounds. Expansion rate bounds for both former USSR regions are set at zero, eliminating the possibility of any expansion of capacity to occur during the simulation. Note that the production of lumber, for example, can still expand to the capacity limit, if capacity is under-utilized. The capacity is allowed to contract by as much as 20 percent per year if historical profitability is negative and capacity is under-utilized.

Projecting future levels of harvesting capacity is not as straightforward in CGTM since there is no physical capital measure at the log level in the model.<sup>4</sup> Instead harvesting

---

<sup>3</sup> see Cardellichio *et al.* (1989)

<sup>4</sup> There exists an economic measure--capital costs--which can be manipulated in the model. However, data does not exist which can be used to project capital costs required to replace 5% of the existing capital stock each year, for example.

capacity is used to determine the portion of the growing stock that would be available. The timber submodel in CGTM is utilized to project a decline in the available growing stock to mimic the harvesting capacity constraint. The approach employed is described with the following relationships.

Next period growing stock is defined as:

$$GS+1 = GS + G - H.$$

Growing stock in the next period (GS+1) is equal to present period growing stock (GS) plus growth (G) minus harvest (H). Growth is adjusted by the following formula to compensate the reduction in growing stock due to harvests but not harvesting capacity:

$$G = dGS + H$$

where dGS is the change in growing stock, GS+1 - GS. For growing stock to decline by 5 percent, dGS is made equal to -0.05. Growth is calibrated for 1992 using information on the percentage of harvesting capacity utilized in that year. For example, in 1992, in Western former USSR, an estimated 82 percent of the harvesting capacity was utilized. Hence a relationship between total roundwood harvest and estimated growth required to reduce growing stock by 5 percent can be defined by:

$$G = (-0.05/0.82)*H + H, \text{ for 1992.}^5$$

This relationship is used to define a growth projection to adjust that portion of the growing stock that is available based on harvesting capacity. For subsequent years the reduction in harvesting capacity is implemented by projecting a 5 percent decline in the growth of available roundwood growing stock from the 1992 base level. Growth projections were constructed for coniferous roundwood in Western and Eastern former USSR (82 and 55 percent utilization rates were employed) and Western former USSR deciduous roundwood (47 percent utilization rate was employed).

---

<sup>5</sup> Note that  $(-0.05/0.82)*H$  comes from  $dGS = -0.05GS$  and  $GS = H/0.82$ . The intuition behind the relationship between timber growth and harvests is evident when we consider how growing stock versus harvesting capacity are defined. When growing stocks are viewed as timber stock, harvests represent the consumption of timber. Harvests reduce the growing stock available for next period consumption by its totality. This is not the case for harvesting capacity. When growing stock is considered as harvesting capacity, only a portion--5 percent--is not available for next period consumption. Growth, therefore, calibrates the growing stock by replacing the portion of harvest that represents the non-consumptive portion of harvesting capacity. The assumption made is that once we have calibrated the growth for the base year so that timber growing stock is equivalent to the stock of harvesting capacity, future period declines in available harvesting capacity can be approximated by reducing the growth parameter by 5%. This assumption is tested graphically by illustrating the implied harvesting capacity constraint and harvest levels when results are presented. Alternatively, a more precise estimate of capacity constraints can be made by iterating model solutions and calibrating the growth parameter for each year with new estimates of capacity utilization.

A trade linkage between the Western and Eastern coniferous markets of the former USSR is defined to allow forest products to flow from the East to the West. Unlike other trade flows, trade levels between East and West former USSR are determined by price differentials between the two regions and the cost of transport. Trade with non-former Soviet Union republics were projected using a conservative outlook on export potential (Backman and Waggener 1994).

Finally, two transport rates are defined: a Russian domestic rate of \$6.50 per cubic meter (1992 level); and a world rate of \$34.00 per cubic meter (1992 level).

## STUDY LIMITATIONS

Four limitations to the present approach are recognized. First, processing capacity expansion and contraction react to historical profitability and not expected prices. There is no linkage in the model that would allow capital shortages to be perceived in advance and producers to begin to invest in processing capacity before it is needed.

Second, no actual measure of harvesting capacity is employed. Rather the growing stock is utilized to define available stock for harvesting capacity constraints. A limitation of using changes in growth to measure the capacity stock is that growing stock can be saved for future harvests, a behavior that is not necessarily true for Russia capital stock. The approach assumes that there is available growing stock sufficient to meet harvesting capacity requirements; an assumption which would appear to be true for the time frame of interest.

Third, the assumption of a competitive market equilibrium is imposed. The possibility that recent costs in purchasing wood products in Russia are associated with the lack of information and market power are not incorporated in the study.

Fourth, linkages between deciduous and coniferous markets are not direct, limiting the ability of the CGTM to endogenize substitution. Given these study limitations, the results presented must be viewed as a first step in describing the likely development of the former USSR forest sectors.

## SCENARIOS

Scenario analysis is used to test the sensitivity of various assumptions. A determination of the most likely path of future harvest flows from the former USSR cannot be made unless there is an understanding of the impact of underlying assumptions guiding harvest levels. The purpose of the scenario analysis is to produce estimates of changes in projected harvest flows as assumptions on demand, transportation cost, exports and capital investments, including alternative policies, are varied.

Demand projections are constructed for lumber and pulp.<sup>6</sup> Two lumber projections are made for the Western former USSR region. The first demand scenario excludes demand of the former Soviet Union European and Asian republics from Western Russia. This projection assumes that Western Russia would no longer continue to supply the former republics.

Additional assumptions used in the first scenario include: (i) a 5 percent decline in harvesting capacity in the West and East former USSR regions; (ii) no expansion of processing capacity; (iii) an estimated 20% decline in consumption in 1993, zero demand in 1994 and an increase of 1 percent per year afterwards; and (iv) a conservative forecast of exports to non-former Soviet Union markets. The first scenario also uses the Russian estimate of transportation cost between Eastern and Western former USSR.

The first scenario produces an initial point of analysis from which to construct a most-likely forecast of harvest flows from the former Soviet Union republics, particularly Russia. This first scenario attempts to capture recent declines in domestic demand and the likelihood that an economic recovery will begin. It also characterizes the assumption of declining exports to former Soviet republics in the West. It serves as a baseline for comparisons to other scenarios with higher demands and other policy changes.

Scenario 2 characterizes a second Western Russian demand assumption. This scenario includes demand from consumption in European and Asian republics. Russia would continue to supply forest products to the former republics under this demand projection. The second scenario examines the sensitivity of demand on harvest flows and capacity constraints. The scenario imposes the requirement that Western Russia supplies the former European and Asian republics. A 20% increase in demand is made for 1993. The scenario also incorporates a 3% (rather than 1%) increase in consumption following 1993. The scenario is an attempt to measure the influence of higher demand on harvest flow projections. The scenario also contains a policy component regarding supply of Russian products to the former Soviet European and Asian republics as an important element of the demand.

The next three scenarios are considered policy scenarios since they examine impacts of potential policy instruments on projected harvest flows. Scenario 3 examines the effect of reducing export levels to zero to non-former Soviet markets. The initial scenario, defined above, limits the amount of exports that are allowed to leave the former Soviet Union and enter international markets. The policy tested in Scenario 3, banning exports, completely isolates the former USSR forest sector from international demands.

Exports, however, provide hard currency income. The decision to export or not becomes a policy question since exports may become a source for needed domestic consumption when domestic supplies are in short supply. When prices rise in a domestic market due to short supply conditions, exports are diverted from international markets to meet part of the

---

<sup>6</sup> Pulp demand projections are provided to account for the consumption of pulpwood since pulpwood is a drawn-down on total roundwood fiber supply, the demand for which must be met before examining production of lumber and trade flows.

supply shortage. Since the expected level of exports from Russia will be determined by a planning function, rather than international markets, we examine the effect of eliminating exports from the former USSR on the domestic and international markets with this scenario.

A fourth scenario examines the impact of using an estimated international transportation cost rate within the former Soviet Union. The scenario is an attempt to measure the impact of removing low, distorted, internal transportation costs between the East and West on the forest sector.

A fifth scenario examines the impacts of maintaining the 1994 level of harvesting capacity in Western former USSR. It is constructed to help answer the question of how can maintaining the current harvesting capacity reduce the impact of declining capacity in the future. The results from this scenario may also be useful for estimating a target level of investment needed. The target level when combined with capital costs would provide a cost estimate associated with maintaining a viable forest sector in Russia.

## RESULTS

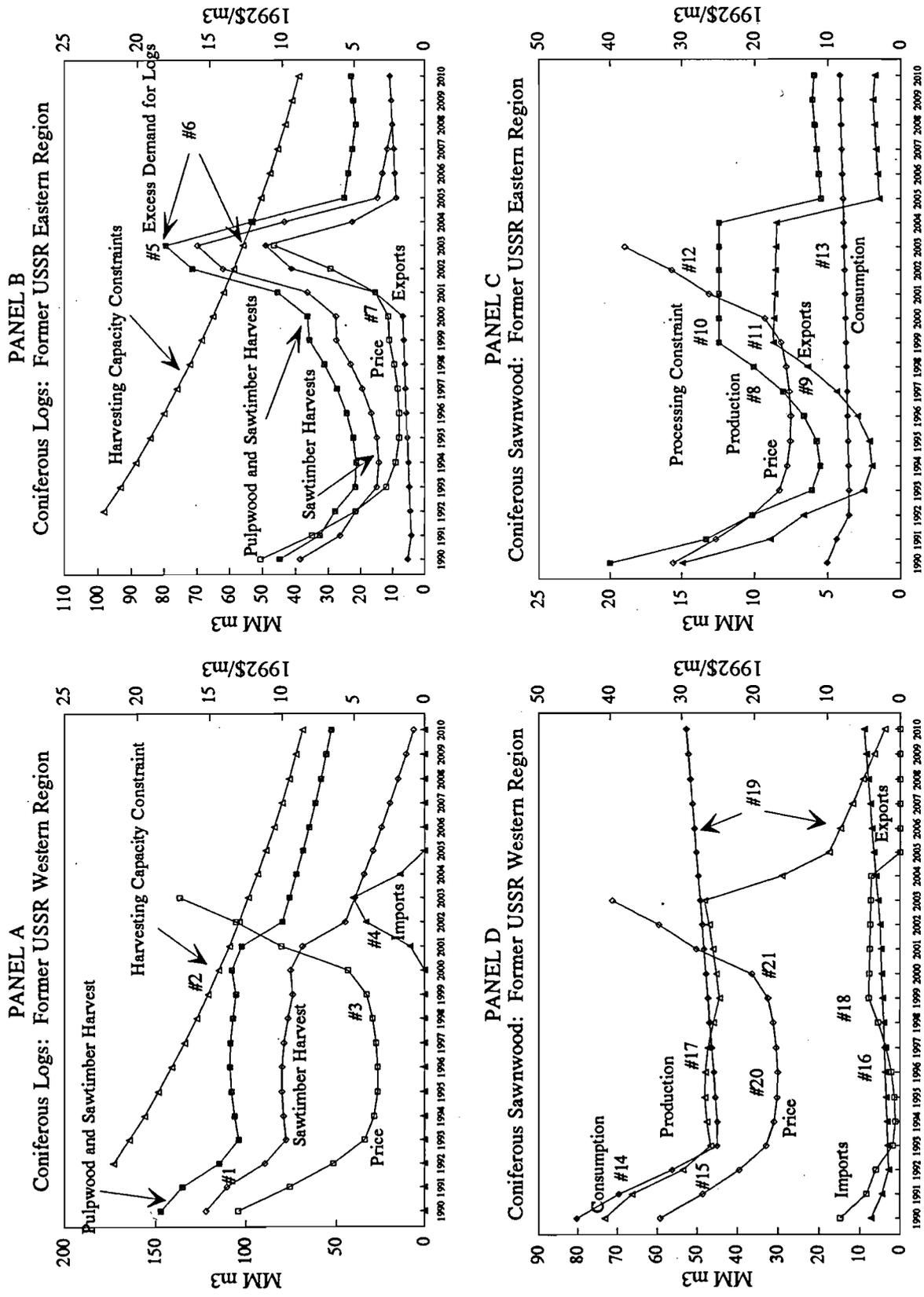
The harvest capacity constraint will force substantial declines in log flows in the former USSR forest sector. The constraint will reduce output, first in the Western region, where demand is strongest, followed by a decline in production in the Eastern region. The Eastern region will provide lumber products to meet Western regional demand until the processing capacity constraint limits the East's ability to process logs. Under constrained lumber exports, log trade may or may not take place if the harvesting constraint in the East does not limit the production of logs and if prices rise sufficiently in the West to stimulate log trade. A binding harvesting constraint in the East will make this outcome improbable however. Eventually, processing capacity will also limit production in the West. Harvesting capacity constraints and a shortage of logs from the East will occur before any constraint in processing in the West is apparent.

With likely declines in the availability of coniferous products in the Western market, deciduous lumber production may begin to provide an increasing share of the overall lumber market. However, even with its current low capacity utilization of about 47%, it is likely that harvesting capacity constraints will limit production in the deciduous sector at the time when harvesting capacity is constraining production in the softwood sector.

The timing of any collapse in production depends on assumptions on demand growth, transportation cost, export levels, capacity deterioration rates and investments in harvest and production capacity. Following subsections describe results of the scenario analysis employed to analyze the sensitivity of assumptions utilized in projecting harvest flows for the former USSR forest sector.

Results of the study are reported using graphs. Figure 1 presents projections for the initial scenario. Since similar figures will be used in the presentation of results for the sensitivity analysis, we will describe Figure 1 in some detail.

Figure 1. Production, consumption, prices and trade projections for BASE scenario



Graphs are presented in a group in each figure. They display model projections of production, prices, consumption and trade for logs and sawnwood for the two former Soviet Union regions. The graphs in Figure 1 are: Western former USSR logs (Panel A); Eastern former USSR logs (Panel B); Eastern former USSR sawnwood (Panel C); and, Western former USSR sawnwood (Panel D). Harvest and processing capacity constraints are depicted where appropriate. As will become evident during the presentation of results, these graphs should be considered jointly since projections made for log and sawnwood markets for former USSR regions are closely related.

Important results are labeled in Figure 1 to facilitate the interpretation. First (#1), in Panel A, Western former USSR sawtimber production declines due to the observed decline in lumber consumption and our assumption on former Soviet European and Asian republic demand. Production stabilizes in response to recovering demand until the declining harvest capacity constraint becomes effective in 2000 (#2).<sup>7</sup> Domestic log prices begin climbing by the late 1990's (#3). Prices rise sharply as harvest constraints take effect. Log imports from the former Soviet Union's Eastern region grow to meet Western former USSR log requirement (#4). Approximately 40 million cubic meters of Eastern Russian logs are required to meet Western former USSR demands in 2003. The large log requirement is needed to meet roundwood--pulpwood and sawtimber--requirements in Western former USSR. It is important to note at this point that, because the modeling approach utilized growth, rather than growing stock, as the measure of the harvesting capacity constraint, the import projection result presented in Panel A is an estimate of the amount needed to meet demand requirements (see footnotes 5 and 7). It can not be interpreted as an actual projection of logs forthcoming from the East. Conditions in the East will prevent the level of imports required by the West to meet its projected demand as will be explained below.

Panel B in Figure 1 depicts the model projections for Eastern former USSR. In the region, the growth in log harvests results in production levels approaching the capacity constraint early in the next century (#5). Excess demand from the Western region surpasses the harvesting capacity limit. The modeling results suggest that the harvesting capacity constraint will likely limit Eastern former USSR's ability to export logs to meet Western regional requirements (#6). One should also note the similar price effect observed in Eastern former USSR (#7). In both regions the price effect is relatively small due to the low, initial domestic price.

Panel C in Figure 1 presents model projections for the sawnwood market for Eastern former Soviet Union. The observed growth in lumber production (#8) is the result of a growth in exports to Western former Soviet Union (#9). The model results suggests that processing capacity in Eastern former Soviet Union would limit lumber production (#10) prior to harvesting capacity limiting log harvests. As a result, lumber exports to Western former Soviet Union would be constrained by 1999 (#11). Lumber prices in Eastern former Soviet Union rise when capacity constraints begin to take effect, reaching levels comparable with

---

<sup>7</sup> The harvesting constraint is defined as the point where production declines substantially and may not correspond exactly to the harvesting capacity constraint illustrated in the figures. The reason for this result is related to the use of the growth measure to estimate harvesting capacity constraints.

1990 levels (#12). The exogenous projection of domestic consumption is also provided in Panel C (#13). As is evident in the graph, domestic consumption in Eastern former Soviet Union is not a major factor determining harvest behavior.

Panel D in Figure 1 describes projections in the lumber market for Western former Soviet Union. The projected level of consumption is provided by #14 and one can note the importance in determining the present results. The projected consumption level has been adjusted downward in 1993 by 20% to remove the demand requirement of the former Soviet Union republics (#15). Hence the demand projection in Panel D represents consumption forecast for the Russian Republic. After an initial observed decline in 1991, 1992 and 1993 projected consumption is assumed to grow at 1% per year. As log prices begin growing in the Western region (#3 Panel A), lumber imports from the lower-cost Eastern region begin to expand (#16 and #9 Panel C). Lumber production (#17) declines as export demand and domestic consumption is met with increasing imports from the East. The result illustrates the role of Eastern former USSR in supplying the Western market if transport costs are low enough and transport costs and prices rise sufficiently to allow shipments from the East to the West to occur.

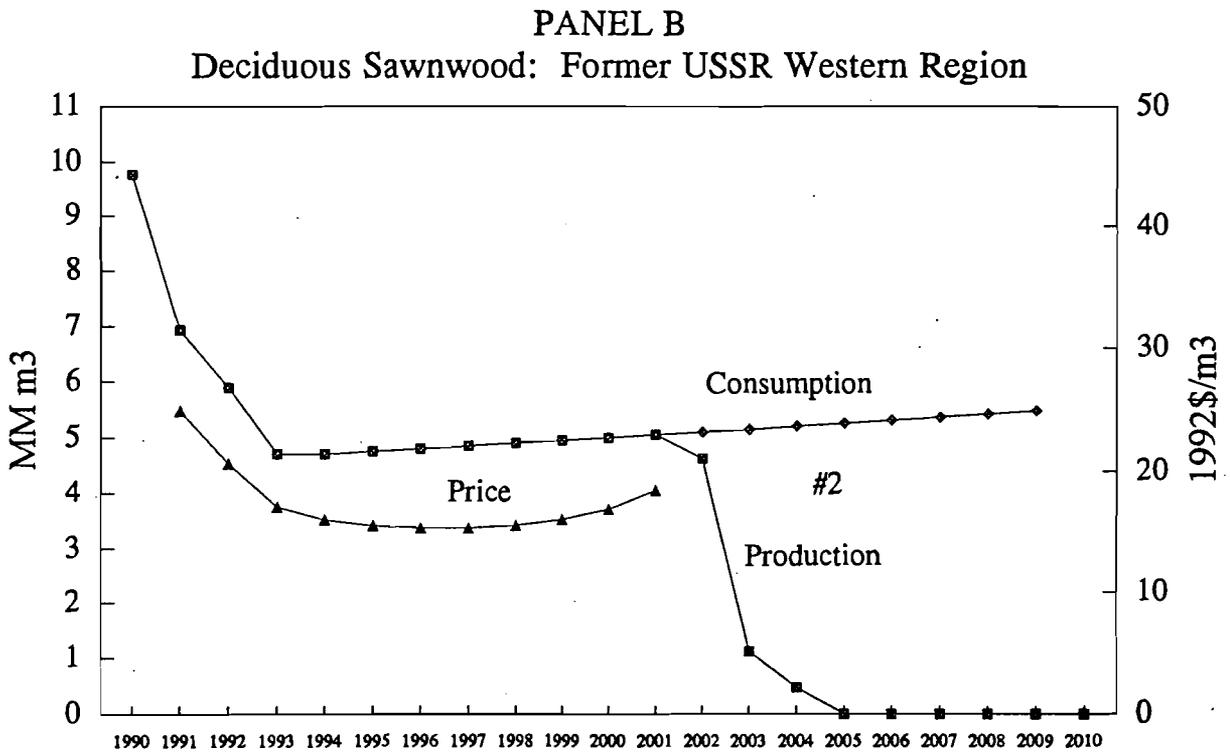
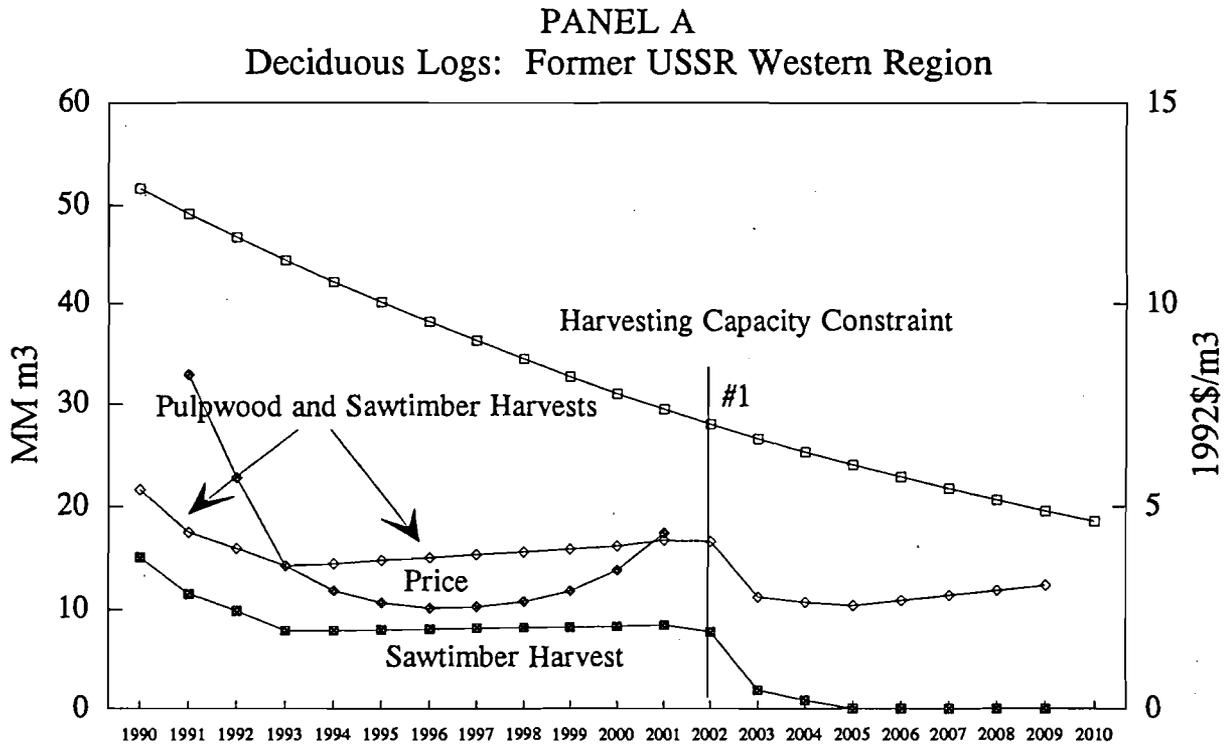
By 1999 however, processing capital constraints in Eastern former Soviet Union limit lumber imports by the West (#18). Higher domestic and export demand must be met with domestic log production. At this point, harvesting capacity limits log production and log imports from the East take place (#4 Panel A). However, harvesting and processing capacity constraints in the Eastern region will most likely prevent adequate levels of products or logs to reach the Western region. As a result, there is likely to be insufficient supplies to meet domestic demand in Western Russia and the region's export demand by the later half of this decade (#19). Finally, there is little observed price response prior to the capacity constraint that would indicate the large amount of investment needed to fill consumption needs (#19). Only after capacity constraints become binding do prices increase significantly (#20).

In addition to coniferous lumber production, deciduous log are also consumed to produce hardwood lumber. As coniferous production is reduced due to harvesting capacity constraints in the West, it is plausible that there will be some substitution with deciduous lumber. Figure 2 presents the outlook in the deciduous market in Western former Soviet Union. Panel A indicates likely constraints on production will exist early in the next century, around the timing of the capacity constraints on the coniferous forest sector (#1). It is unlikely therefore that the deciduous resource base can provide large amounts of products to substitute for the decline in coniferous production without investments in harvesting capacity. As a result of harvesting constraints, deciduous lumber production declines as illustrated in Panel B #2.

#### Demand Growth: Scenario 2

The impact that high demand growth may have on the use of existing capacity is obvious from the result of our second scenario. Embedded in the high demand forecast is the consumption requirement of the former Soviet European and Asian republics--an adjustment of 20% in 1993. With the breakup of the former Soviet Union, it is not clear how the

Figure 2. Production, consumption and price outlook for deciduous market



demand from the former Soviet European and Asian republics would be met. The second scenario modifies the demand growth of Russia and the linkage of consumption requirements between the former republics and Western Russia to examine the likely impacts of higher demand.

Increasing demand projections from 1 to 3 percent and exporting products to European and Asian former Soviet republics hastens the impact of capacity constraints. Harvesting and processing capacity limit production in the Eastern region earlier than Scenario 1. As a result, lumber exports to the West decline. The decline in lumber exports coincide with the harvesting capacity constraint in the West. The added demand for Eastern logs from the West occurs when harvesting capacity will constrain Eastern Russia's log production. As a result, an estimated log requirement of 25 million cubic meters will not be met with some probability and will lead to a substantial disruption of supply in the Russian domestic sector.

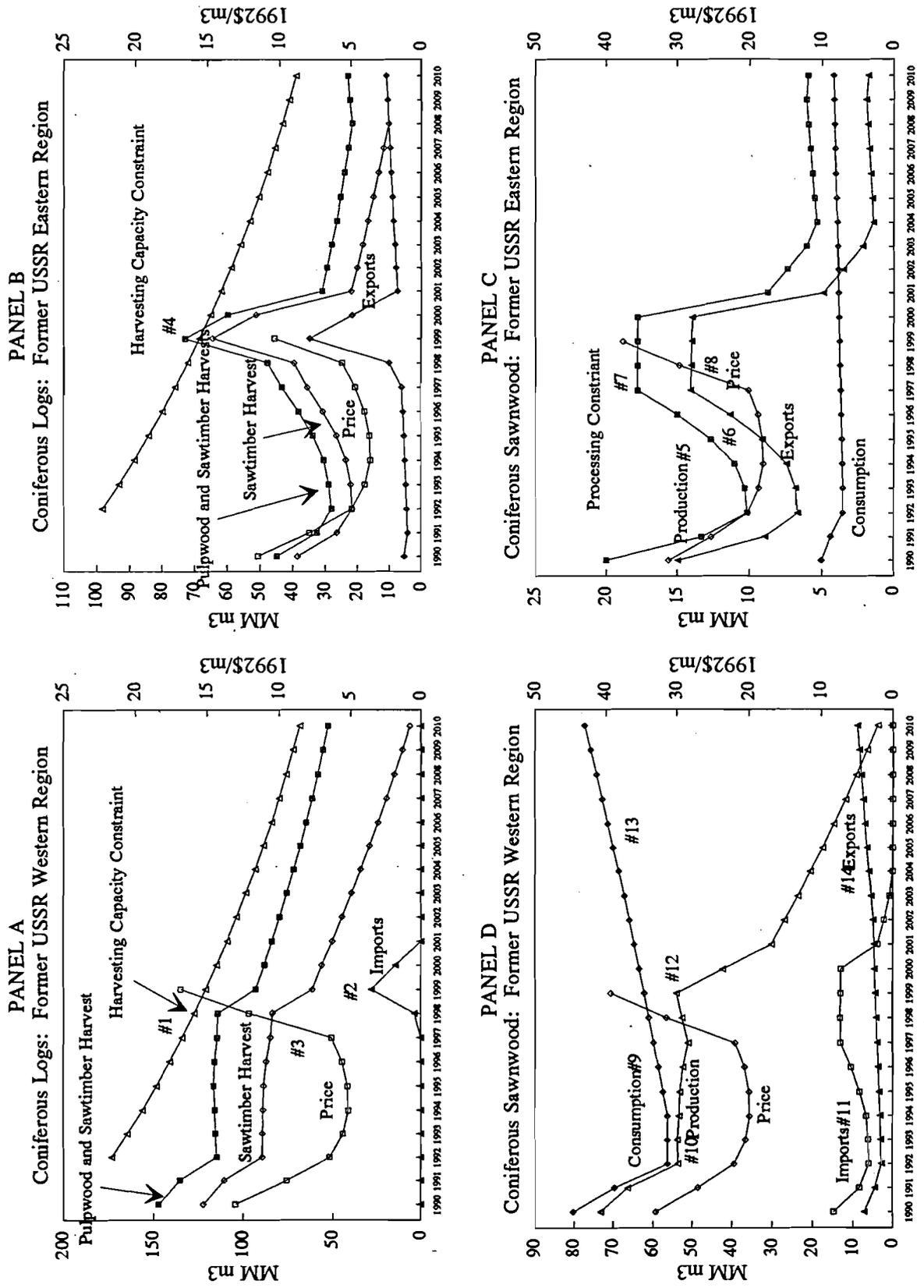
Results are displayed in Figure 3 and their discussion follows a similar format used with Figure 1. The inability to maintain production longer into the future comes from the higher demand requirements. As a result the harvest capacity constraint is binding a couple of years earlier (#1). The need to import logs earlier--over 20 million cubic meters for the first year (#2)--is the result of higher sawlog and pulpwood demand needs in the West region. Again, it is important to note that the estimated requirement from the Eastern Russian region is not a forecast, but a measure of the log shortage likely to take place. Growth in log prices more than double during the first period when harvest capacity is binding (#3). Previous to the price growth, there is no appreciable change in price. Higher demand has resulted in higher domestic prices on average.

Panel B depicts log market projections for Eastern former Soviet Union. As in the previous scenario, it is likely that the harvesting capacity constraint will limit Eastern former Soviet Union's ability to export the required log to the western market (#4). The under-utilized harvesting capacity in Eastern former Soviet Union is employed sooner than previously reported since harvesting capacity constrains production in the Western former Soviet Union earlier.

Panel C presents model projections for the sawnwood market for Eastern Russia. As in the previous scenario, the observed growth in lumber production (#5) is the result of the growth in exports to Western former Soviet Union (#6). The binding processing capacity constraint which occurs in 1997 (#7) is also obvious. Lumber prices begin rising (#8) as a result of the constraints on production and higher log demand.

Panel D provides model projections for the lumber market for Western former Soviet Union. The domestic consumption (#9) is met with western lumber production (#10) and imports from Eastern former USSR (#11). As capacity constraints in the Eastern Russian region reduce lumber imports, additional logs are harvested in the West until constrained by harvesting capacity. Lumber production (#12) can only continue to grow if logs can be imported from the East. Since the Eastern Russian region will most likely be limited by their harvesting capacity constraint, production levels indicated in (#12) would most likely not occur. As a result, the production projection would not meet consumption needs (#13)

Figure 3. Production, consumption, prices and trade projections for HIGH DEMAND scenario



and exports to non-former Soviet markets (#14). Because lumber markets between East and West are linked through trade flows, price behavior in Western former Soviet Union is similar to Eastern former Soviet Union (#15).

#### Export Levels: Scenario 3

Exports to non-former Soviet Union markets are a potential additional source of logs and lumber that may be used to meet domestic requirements. The fourth scenario examines the impact of reducing the level of exports from Russia to international markets.

The result indicates only a small gain in time before there is a binding constraint on harvesting and processing capacity. Figure 4 present the major result of this sensitivity analysis. Harvesting constraints are pushed back 2 to 4 years. However, log prices decline as the additional domestic supply applies downward pressure on log prices. The downward movement of prices is opposite to the desired direction to improve returns to harvesting to create more investment opportunities.

Figure 5 illustrates the growth in the price differential between domestic and international prices as a result of banning log and lumber exports. Price changes in the figure are defined as the difference in observed logs prices in the Export Scenario (Scenario 3) and the Base Scenario (Scenario 1). Log prices increase in international markets as a result of banning log exports to Pacific Rim and European markets (Panel A). The observed increase in the average sawlog price in European markets of Finland, Sweden and Western Europe is less than the price increase observed in the Pacific Rim markets. Price level declines for the two former Soviet Union regions are also recorded in the graph. While price level changes in different markets are similar (due to equilibrium conditions), there will be observed differences in the percentage change in prices. Hence, the percentage change in log prices in the Japanese market is less (4 percent in 2010) than in the Pacific Northwest (11 percent), for example. Similarly, the change in the log price is 8 percent for Finland and 6 percent for Western Europe.

Figure 5, Panel B displays the changes in price levels for lumber markets. Since trade in lumber occurs between East and West former Soviet Union, price level changes are similar for the two regions. Similarly, price level changes observed in Europe and the Pacific Rim markets are identical. The price level changes observed in both the lumber and log markets trend upwards due to increasing exports in the demand scenario developed for the two domestic regions; i.e. upward trend in exports. As exports are banned, a larger price effect is observed over time since greater level of exports is removed from international markets.

#### Transportation Costs between East and West: Scenario 4

The Eastern region of the former Soviet Union acts as a marginal producer to service the Western region. Low demand and relatively high levels of processing capacity make it a source of high-cost supply for the Western region. Low transportation cost enables the Eastern region to service the Western region. Higher transportation costs will force the West to uses its capital more quickly and accelerates the timing of binding capacity constraints.

Figure 4. Production and prices associated with a NO EXPORT scenario

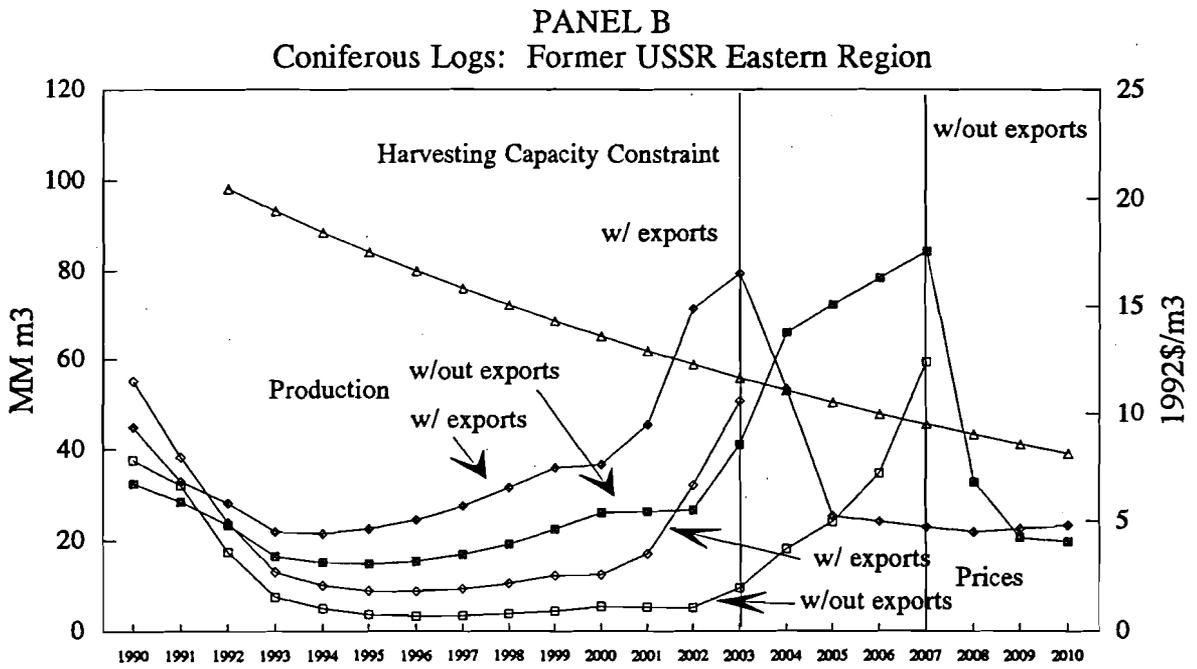
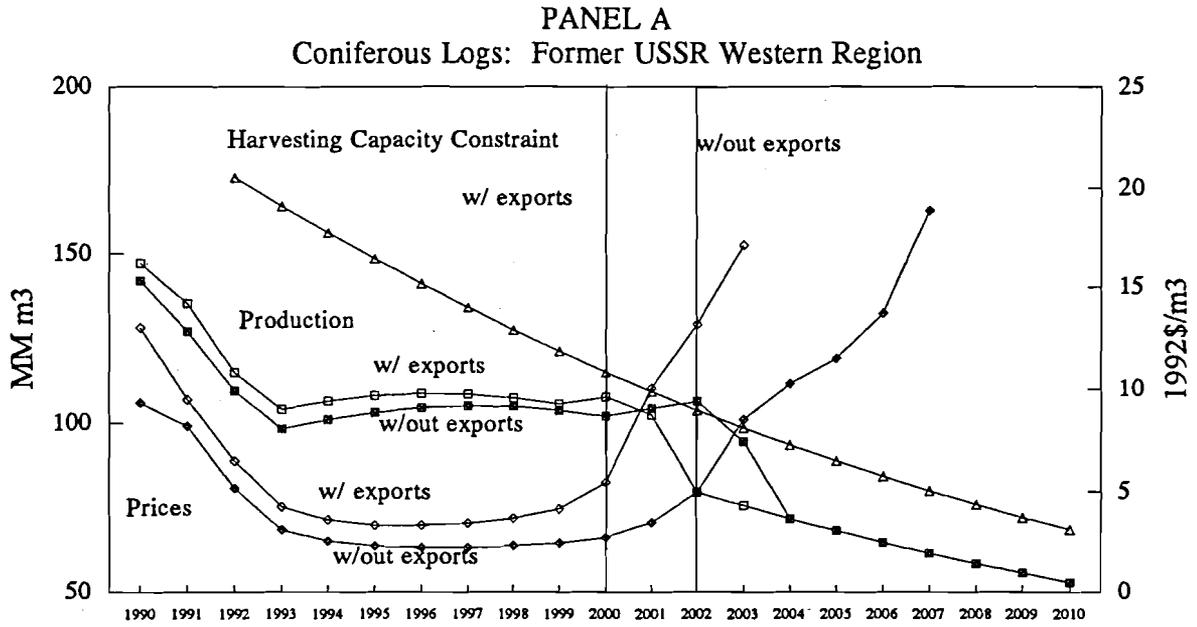
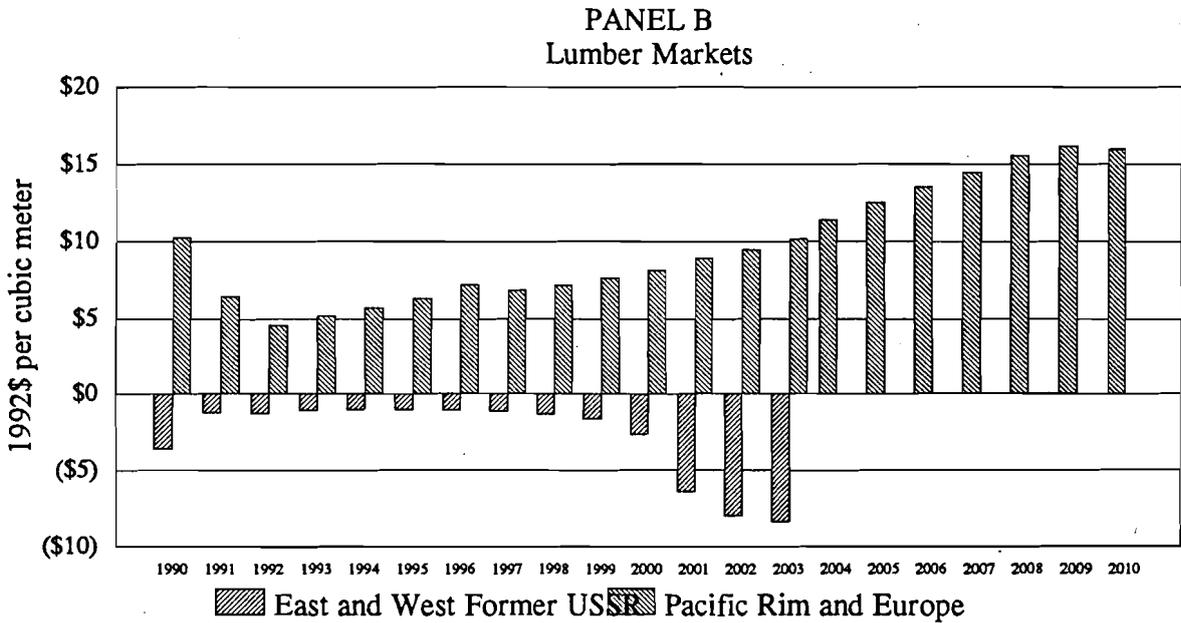
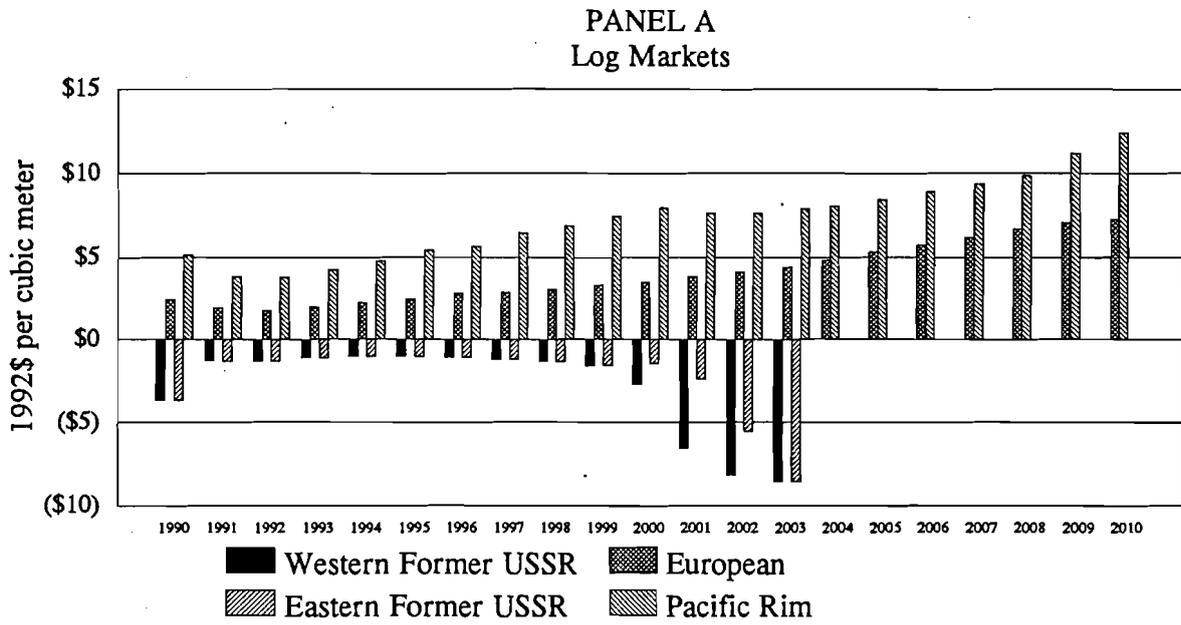


Figure 5. Price level changes in Pacific Rim, European, Eastern Former USSR and Western Former USSR markets associated with a zero level of exports from the Former Soviet Union.



The result of the scenario analysis indicates that higher transportation costs between the East and the West reduce the amount of sawnwood imported by the West. As a result, a higher level of log production occurs in the West, pushing forward the time when harvesting capacity will reduce log output in the West.

#### Investments: Scenario 5

A final scenario maintains capital investments at 1994 levels for Western former Soviet Union. No investments are introduced in Eastern former USSR. The result of the scenario illustrates the potential impact of investment policies for the region. Capacity constraints limit log production near the end of the time frame of the analysis (2010).

Figure 6 presents the result of the scenario analysis. Panel A illustrates the projected production, prices, imports and harvesting capacity constraint for Western former USSR. Maintaining harvesting capacity would allow log production to proceed unconstrained until around 2008. Panel B displays the projected production, prices, exports and the harvesting capacity constraint in Eastern former USSR. The harvesting capacity constraint is likely to become important during the later half of the next decade. As shown in Panel C, processing capacity will also likely become scarce by 2005. Note that the effect of maintaining investments in harvesting capacity in Western Russia reduces the need to import lumber from the East. As a result processing capacity is likely to shrink in the East--equivalent to about 4% annual decline--than in the previous result.

## DISCUSSION

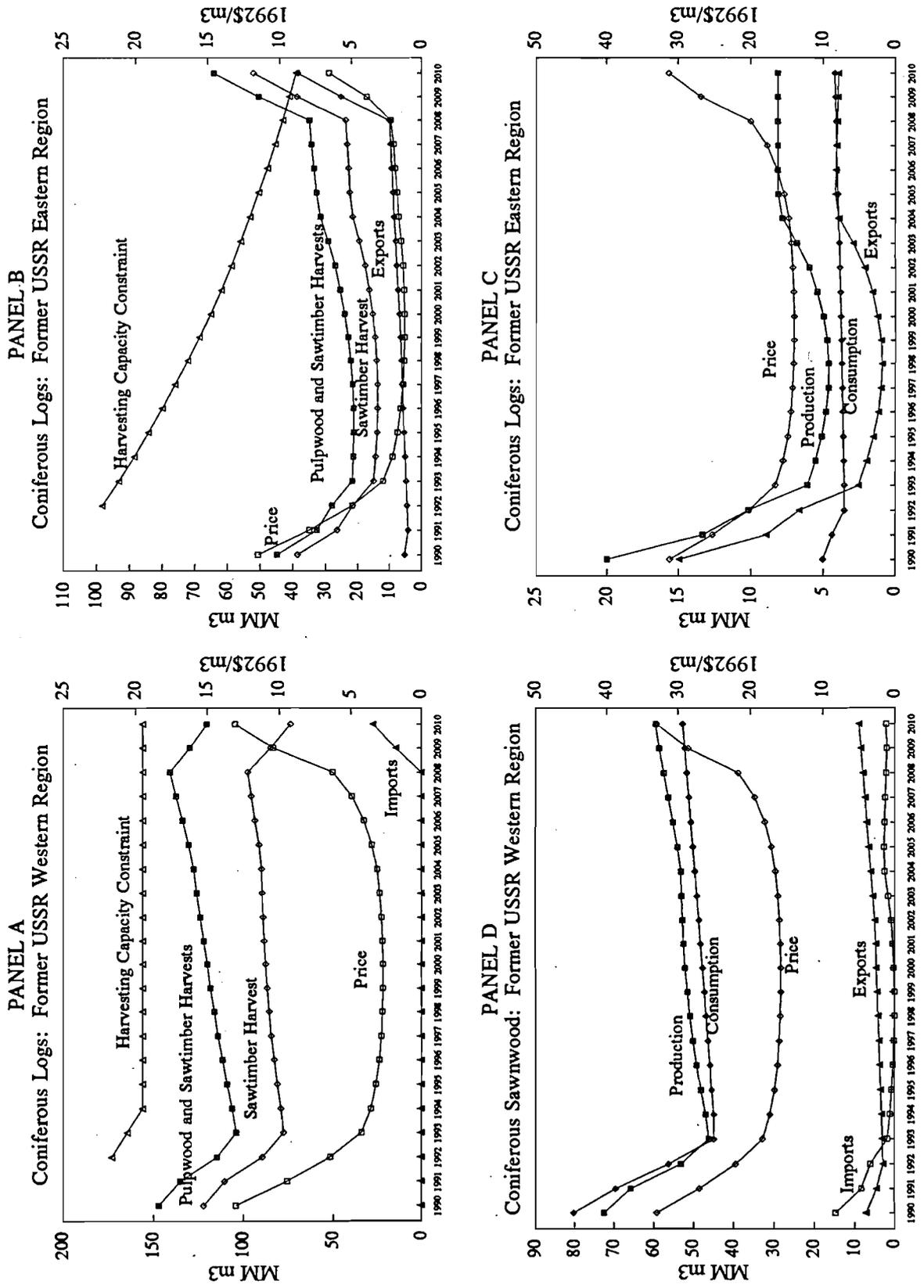
This section discusses the implications of the projected future harvest flows presented above. The discussion is centered around three areas of interest. What are the implications for the domestic economy? What are the implications for the international markets? And, what impacts may an international response have on the domestic economy?

### The Domestic Forest Sector

There are indications that the domestic forest sector is in need of large levels of investments in harvesting and processing. Production levels from the forest sector will eventually decline without adequate investments. The delay in implementing an investment policy could have large impacts early in the next decade. Investment needs are greater in the Western region of the former USSR where the harvesting capacity constraint is more likely to be a problem earlier.

Ties with the European and the Asian republics will place additional strains on harvesting capacity in Western Russia. Maintaining economic ties with these markets may be beneficial if they begin to purchase forest products at international prices using hard currencies. However, any supply to the former republics translates into reduced supplies to the domestic Russian market unless investments are undertaken.

Figure 6. Production, consumption, prices and trade projections for the INVESTMENT scenario



Low domestic prices will not rise fast enough to signal investment needs. Serious considerations must be made to maintain and upgrade the existing capacity to meet domestic demands in the upcoming decade. While the study does not purport to capture the linkage between price expectations and levels of investments, results indicate that domestic price will need to rise substantially to attract investment required to meet domestic demand. Added costs to wood producers through either lack of information or non-competitive market structure will likely reduce the incentive to invest in wood products industries.

The lack of serious efforts to invest in the Russian forest sector will most likely translate into reduced demand through substitution. Lost wood product markets may be difficult to recapture, particularly if the cost of production is high and prospects for returns on investments are low. A smaller wood products market may translate into lower levels of forest management with some environmental consequences.

The relationship in forest products trade between East and West is closely linked with the low, distorted, internal transportation cost. The East is seen as an additional source of products for the West. Should the West begin to increase its harvesting capacity through investments, there will be less dependence on the East to supply products. The result of such a scenario suggests a much smaller production base than presently exists in the East. As such, investments in processing capacity and infrastructure are more relevant for the East.

#### International Markets

Russia's choice to restrict exports results in lower domestic prices than would otherwise exist. Such a policy isolates the domestic market from price movements in the international markets where shortages in supply exist. Such a policy also creates the opportunity for agents with information on international prices to capture larger profits without any incentive to invest in domestic processing industries. Further limiting the export of products does not appear to provide substantial gains. An important exception may exist with the former republics in Europe and Asia, should economic linkages continue with distorted domestic prices. Therefore, eliminating trade with hard-currency countries is a costly policy with questionable gains. Hard-currency trade in forest products results in higher revenues as international buyers pay higher prices. While diverting exports to domestic markets to gain additional harvesting capacity delays capacity limits for a few years, it does not reduce the need to invest in the sector. In addition, further isolation of export markets reduces log prices. Lower log prices will not provide incentives for further investments in Russia which will require sufficient returns to pay for capital costs.

Investments will also be required to provide accessible volume for export markets, particularly in the East. The higher international price would attract investments in the exporting sector, with some potential benefits for the domestic market. As such, these investments should be encouraged and even expanded and should not be penalized by domestic requirements.

Russia may become a higher cost producer in international markets as distortions that affect returns are removed. Productivity of forests in Russia lag behind other forest regions

globally. With the need for large investments to access mature timber reserves, log costs may surpass those of other regions. If so, then Russia's role in export markets will decline.

#### International Impacts on Domestic Markets

The principal concern of international impacts on the domestic market is its effect on prices. Export controls lead to price differences between international and domestic markets. As a result there exists a large wedge between the international and domestic price. The price wedge has two effects. First, the international price signal will direct investments to respond to international market demands. This behavior may result in less investment in the domestic sector than desirable.

The second effect is associated with higher domestic prices and its impact on the ability of a market in transition to pay these higher prices. Economic ties with market economies will eventually reduce the wedge between the domestic and international price. The opening of the domestic market will force international prices on domestic consumers. This will lead to a large increase in the cost of wood products, with potential adverse effects on the domestic forest sector.

Figures 7 and 8 illustrate the potential impact of international pricing on domestic markets in Russia. The approach used to arrive at the potential price path assumes that eventually, log prices will move in a fashion similarly to projected international log prices and domestic market distortions are ultimately eliminated. The first assumption is that the Eastern region of Russian will export logs under open market conditions. If this assumption holds, then price movements in the domestic market should follow the estimated international price level depicted in Figure 7. In addition, we assume that the estimated price is a market price and an equilibrium price between the international and domestic sector is obtained. In fact, as discussed earlier, eliminating cost distortions may make Russian wood more costly than depicted in Figure 7. What will it take to reach this assumed price level in the future? The potential price path is given by the line connecting the two price levels in the figure. The potential price path diverges from the domestic price level and assumes prices will be managed as a policy strategy (through pricing ceilings or pricing supports) since to go from the domestic price level to the international price level in one step would cause a substantial hardship on the ability to pay for wood products by the domestic sector. The analysis implies that an annual increase of \$4.26 per cubic meter would move domestic prices to international levels by 2010.

A similar argument is made for Western Former USSR (Figure 8). In this analysis however, it must be noted that log exports may not be forthcoming, rather log imports may be required from Eastern Russia. Nevertheless, price arbitrage should lead to log price equalization.

Figure 7. Domestic price level, international price level and potential price path to adjust domestic prices to international levels for Eastern Former USSR.

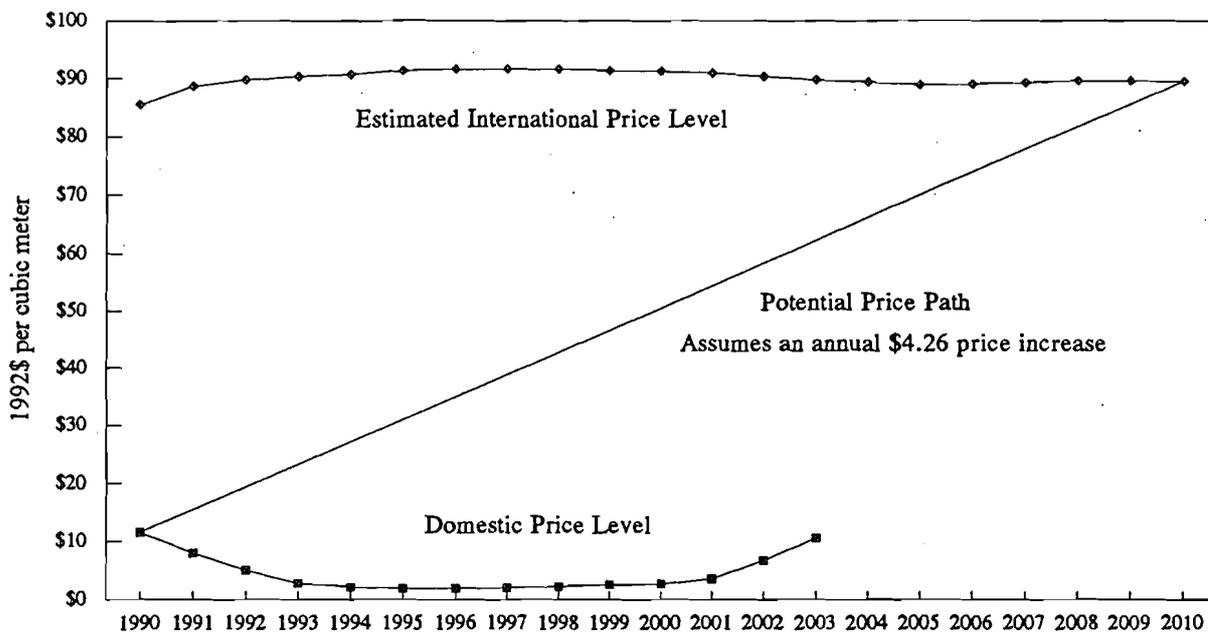
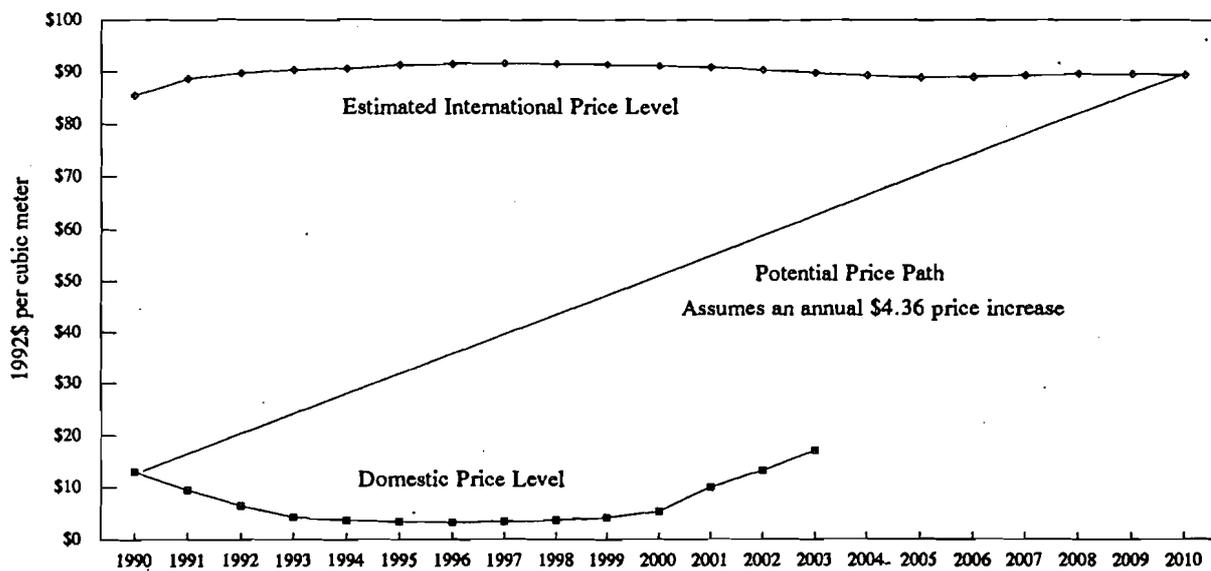


Figure 8. Domestic price level, international price level and potential price path to adjust domestic prices to international levels for Western Former USSR.



## CONCLUSIONS

Two conclusions are drawn from the study. First, a breakdown of harvesting and processing capacity is imminent. The timing of the event will be affected by demand growth, exports to the republics and hard-currency markets, and the level of investments. Second, domestic prices are too low to stimulate investments in the domestic forest sector. Investors, whether they be national or international, will not respond to domestic price signals. It seems plausible to conclude then that investments will occur in the exporting sector before any investment would occur in servicing the domestic markets.

Policies should be directed at correcting price signals. On the one hand, the recent price increase associated with wood scarcity in the Pacific Rim markets provides the incentive for international wood products industries and other investors to take larger risks to negotiate concession rights to wood in Eastern Russia. A price increase caused by supply shortages in international markets should provide a gain for the region. International wood prices would allow investments to be made in infrastructure and capital acquisition, which may then be used to service both Western Russian demands and international markets. Policies should be directed at promoting such investments in the Eastern region. International prices will not continue to grow indefinitely into the future. Reduced demand through substitution and increased supplies from other regions will cause prices to stabilize. Hence, there is an urgent need to capture the opportunity to negotiate international investments in the region that currently exists.

Price signals for the Western region must also reflect market costs of production. In markets where other goods and services also may not reflect true costs of production, it may be difficult to accomplish this. Price stabilization policies should allow for price growth gradually so that eventually, domestic prices are comparable with international prices. There is an urgent need for the Russian industry to internalize the cost associated with depreciating capital and policies should be directed at promoting this activity. The difficulty that faces the Western region is the impact the transition to market economy has had on domestic income. The transition has reduced the ability for Russians to pay for forest products, particularly if higher prices occur without subsequent growth in income. It then becomes important to link price growth with the ability of the population to pay for wood products.

## REFERENCES

BACKMAN, Charles and Thomas WAGGENER. 1994. The Russian forest sector outlook and export potential for unprocessed logs and primary forest products through 2000. CINTRAFOR Working Paper 46. Center for International Trade in Forest Products, College of Forest Resources, University of Washington, Seattle, WA.

CARDELLICHIO, Peter, Y. C. YOUN, D. ADAMS, R. W. JOO and J. CHMELIK. 1989. A preliminary analysis of timber and timber products production, consumption, trade and prices around the Pacific Rim until 2000. CINTRAFOR Working Paper 22. Center for International Trade in Forest Products, College of Forest Resources, University of Washington, Seattle, WA.

CARDELLICHIO, Peter, Y. C. YOUN, C. BINKLEY, J. VINCENT, and D. ADAMS. 1988. An economic analysis of short-run timber supply around the globe. CINTRAFOR Working Paper 18. Center for International Trade in Forest Products, College of Forest Resources, University of Washington, Seattle, WA.

KALLIO, Markku, D. P. DYKSTRA, and C. BINKLEY (Editors). 1987. The Global Forest Sector: An Analytical Perspective. John Wiley & Sons, New York.