EXCHANGE RATES AND THE COMPETITIVENESS OF THE US TIMBER SECTOR IN A GLOBAL ECONOMY

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ABSTRACT

This paper examines the competitiveness of the US timber industry under different exchange rate policies using a dynamic optimization model of global timber markets. We assume that exchange rates affect the cost structure of harvesting and managing forests and simulate the model for baseline conditions and four additional exchange rate policies. Two policies consider a strengthening United States dollar scenario and two policies examine weak South American currencies. Recently South America has increased its share of global timber production and is shipping increasing quantities of timber to the Unites States. The results indicate that US competitiveness in the forestry sector is sensitive both to strong US $ policies and to the weak currency policies pursued by South American governments. A 20% increase in value of the US $ compared to all other currencies can reduce harvests by 4 – 7% in the United States over the next 50 years, while a similar reduction in currency values in South America can reduce U.S. production by around 0.4%. In dollar terms, each additional cubic meter of wood produced in South America due to currency policies can reduce producer surplus in the United States by $100.

INTRODUCTION

Exchange rates can have a large influence on a sector's competitiveness. For a country experiencing depreciation in the value of its currency, production costs compared to other regions of the world decline, making its goods more competitive in the global market. The recent depreciation of the United States dollar (US $) relative to the Euro, Yen, and Canadian Dollar, for instance, has potentially given U.S. manufacturers a leg-up in global competition. Empirically, the link between exchange rates and exports in the forestry sector has been shown by several authors. For example, Uusivuori and Laaksonen (2001) illustrate that a stronger U.S. dollar in the 1990's led to lower exports and increased direct investment by US companies in the forest products industries of competing countries. Hanninen and Toppinen (1999) showed similar results for timber exports from Finland with fluctuations in their exchange rates.

Although future trends in exchange rates are uncertain, recent exchange rate adjustments by economies that compete with the United States in the forest products sector suggests that it is important to consider how future trends in exchange rates may affect the U.S. forest products industry. There is already concern that the U.S. forest products industry is facing competitive pressures from abroad due to fundamental reasons, such as the cost of capital and labor, environmental restrictions, and other factors (i.e., Lippke et al., 2000; Bumgardner et al., 2004). A recent national timber assessment by Haynes (2003) projects that the U.S. forest products industry imports more and exports the same amount over the next 50 years, as foreign competitors gain advantages from lower production costs and fewer environmental restrictions. Given these concerns, it is useful to take a more careful look at the potential effects of exchange rate policies on production and welfare in the U.S. forest products sector.

This paper uses a dynamic global timber market model developed by Sohngen et al. (1999) to explore the effects of several alternative exchange rate scenarios on the domestic industry. The model maximizes the net present value of consumers' plus producer's surplus in global timber markets by optimally managing timberland area, investments, and age class distributions of 145 forest types in 13 regions worldwide. Exchange rate policies are modeled adjusting the cost structure of a region's forest industry (i.e., planting costs, land costs, harvesting costs). Regions experiencing a declining currency value relative to the rest of the world experience relative reductions in the costs of producing timber. Changes in costs are assumed to be proportional to changes in exchange rates in this analysis.

Using a dynamic model of global timber marketsl provides several benefits for this analysis. First, we are able to monitor changes in investment and harvesting patterns and timber prices associated with different types of policies. When policies in one region change, the resulting adjustments in exchange rates can have global effects on production. It is important to account for responses in all other regions. Second, there may be non-financial impacts associated with exchange rate adjustments. For instance, if South America persistently devalues their currency, this could lead to additional investments in plantation forests or it could lead to additional harvesting in currently inaccessible tropical rainforests (or both). It is useful from a policy perspective to understand these non-financial impacts. Third, by utilizing a dynamic optimization model that manages age classes and investments we are able to assess the relative influence of exchange rate policies on currently merchantable timber as well as investments in future stocks of forests. These investments, namely the establishment of fast-growing timber plantations, have become an important component of the global timber market and international trade in timber products in the last 30 years.

The baseline scenario in this model assumes that exchange rates are fixed in the future using an average of those projected by the U.S. Department of Agriculture for the period 2004-2013 (USDA ERS, 2004). This baseline assumes a relatively strong, although stable, United State dollar. Two scenarios are then used to assess the effects of further strengthening in the US $ relative to the rest of the world, following historical trends in U.S. monetary policy. Two additional scenarios examine weak South American currencies. South America is chosen because timber production in this region stands as emerging competition for the US forest products industry. Governments in this region also have historically pursued weak currency values relative to the United States.

The next section describes the methods used to analyze the effects of exchange rate adjustments on timber markets. The third section presents the results for a baseline case and four alternative scenarios that examine how sensitive markets are to adjustments in long trends in exchange rates. The final section provides a brief summary of the findings and presents our concluding remarks.

METHODOLOGY

This paper examines the influence of exchange rate policy on investment and production in industrial timber markets. A global timber market model is utilized to assess how adjustments in exchange rates influence the cost structure of production in 13 regions world-wide (Table 1). The model is a dynamic optimization model built upon the earlier work of Sedjo and Lyon (1990) and Sohngen et al. (1999). The current version is more dis-aggregated and contains more detail on timber production in a number of regions than the earlier versions.

For the analysis in this paper, we make several simplifying assumptions to account for adjustments in exchange rates. First, the timber supply model assumes a single world demand for timber logs with unitary demand elasticity at initial consumption and prices. This abstracts from a number of the demand-side effects that would occur with changes in exchange rates. For example, with a "strong" US $, there would be an increase in demand in US $ denominated countries for all normal goods, while at the same time a decrease in demand for all non- US $ countries. In this study, we assume that the terms-of-trade effects are completely offsetting in the worldwide marked for industrial wood, and hence that aggregate dollar demand for timber is unaffected by our assumptions on exchange rates. This simplifies the analysis, and it allows us to focus on modeling regional supply response to exchange rate policies.

Second, we assume that exchange rate policies are introduced and maintained over long periods of time. This implies that governments are able to pursue policies and implement them efficiently. This is perhaps somewhat unrealistic given that many governments in the world change frequently and exchange rates are often determined by competitive market pressures. Evidence on exchange rates, however, does suggest that trends in exchange rates can persist for many decades (Figure 1), and that some countries will under-take substantial re-valuations on world currency markets to align their exchange rates with domestic interests. To account for sensitivity in how countries adjust their exchange rates, we model both instantaneous changes in exchange rates, as well as adjustments in exchange rate trends to try to capture two different types of policy persistence. Third, we ignore potential volatility in exchange rates, which can also influence trade (Sun and Zhang, 2003). Future analysis will address the volatility issue by incorporating stochastic elements into the modeling framework.

The model used in this study is a dynamic optimization model of global timber markets that maximizes the net present value of consumers' surplus less the costs of production in forestry. Formally, this is:

$$Max\sum_{0}^{\infty}\rho^{t}\left\{\begin{array}{l}\int_{0}^{Q^{*}(t)}\left\{\begin{array}{l}D(Q(H_{a,t}^{1}...H_{a,t}^{I},H_{a,t}^{1}...H_{a,t}^{J},H_{a,t}^{1}...H_{a,t}^{K}),Z_{t})\\ -C_{H}{}^{i}(\cdot)-C_{H}{}^{j}(\cdot)-C_{H}{}^{k}(\cdot)\end{array}\right\}dQ(t)-\\ \sum_{i,k}C_{G}^{i,k}(G_{t}^{i,k},m_{t}^{i,k})-\sum_{j}C_{N}^{j}(N_{t}^{j},m_{t}^{j})-\sum_{i,j,k}R^{i,j,k}(X_{t}^{i,j,k})\end{array}\right\} \quad (1)$$

where $D(Q(\bullet))$ is a global demand function for industrial wood products, $H^{i,j,k}$ is the area of land harvested in the timber types in i, j, or k (managed stock, high value timber, or inaccessible timber), Z_t is a vector of all other goods purchased, and $C_H(\bullet)$ is the cost function for harvesting and transporting logs to mills from each of those types. Marginal harvest costs for temperate and subtropical plantation forests (i and j) are constant, while marginal harvest costs for inaccessible forests rise as additional land is accessed. $C^{i,k}{}_G(\bullet)$ is the cost function for planting land in temperate and previously inaccessible forests, and $C^{j}{}_N(\bullet)$ is the cost function for planting forests in subtropical plantation regions. $G^{i,k}{}_t$ is the area of land planted in types i and k, $N^{j}{}_t$ is the area of land planted in highly valuable plantation forests, and $m^{i,j,k}{}_t$ is the management intensity of those plantings purchased at an established price. It is assumed that the cost function for establishing new plantations rises as the total area of plantations expands. The total area of land in each forest type is given as $X^{i,j,k}_t$, and $R^{i,j,k}(\cdot)$ is a rental function for the opportunity costs of maintaining lands in forests. The rental function represents the supply of land for forestry and is upward sloping in all regions.

One interesting feature of this model is that both accessible and inaccessible forest types are modeled. Harvests in inaccessible forests occur if the marginal value of harvesting a hectare is greater than the marginal access cost of harvesting that hectare. Exchange rate policies can influence harvests in inaccessible forests by making these forests, such as tropical rainforests, cheaper to access if tropical countries are pursuing weak currency valuations. In this analysis, we are able to assess how adjustments in exchange rate policies influence environmental outcomes, such as harvesting of tropical timber in regions like South America.

Exchange rate policy is modeled by adjusting the cost structure in the model. The baseline costs in the model assume a specific set of future exchange rates. These baseline exchange rates are assumed to remain stable over the entire modeling horizon (150 years). The model is solved in 10 year time increments, and the terminal conditions are imposed on the system after 150 years. Only the first 50 years are reported in this analysis.

Alternative exchange rate policies are modeled by applying a scalar adjustment to all factors of production, $C_H(\cdot)$, $C^{i,k}_G(\cdot)$, $C^j_N(\cdot)$, in equation (1) above. When one region's currency depreciates (appreciates) relative to another region's currency, that region's costs of production decrease (increase) relative to other regions. To implement exchange rate adjustments we first calculate a cost adjustment factor for each region j in the model, shown as $\alpha_{j,t}$:

$$\alpha_{j,t} = \left(\frac{Currency_{j,t}^{B}}{(US\$)_t^{B}} \right) \Big/ \left(\frac{Currency_{j,t}^{S}}{(US\$)_t^{S}} \right) \tag{2}$$

In equation (2), the alternative set of future exchange rates, scenarios 1-4, are labeled "S". If region j's currency is appreciating relative to the US $, then $\alpha_{j,t}$ will be increasing and a country's costs will be appreciating relative to costs in the US. The adjustment parameter $\alpha_{i,t}$ is then incorporated in equation (1) as follows:

$$Max \sum_{0}^{\infty} \rho^t \left\{ \begin{array}{l} \int_0^{Q^*(t)} \left\{ \begin{array}{l} D(Q(H_{a,t}^1 \ldots H_{a,t}^I, H_{a,t}^1 \ldots H_{a,t}^J, H_{a,t}^1 \ldots H_{a,t}^K), Z_t) \\ -\alpha_t C_{H^i}(\cdot) - \alpha_t C_{H^j}(\cdot) - \alpha_t C_{H^k}(\cdot) \end{array} \right\} dQ(t) - \\ \sum_{i,k} \alpha_t C_G^{i,k}(G_t^{i,k}, m_t^{i,k}) - \sum_j \alpha_t C_N^j(N_t^j, m_t^j) - \sum_{i,j,k} R^{i,j,k}(X_t^{i,j,k}) \end{array} \right\} \tag{3}$$

The baseline scenario (equation 1) and several alternative policy scenarios (equation 3) are simulated and the results are compared to assess the effects on timber production.

The model aggregates all countries into 13 regions. A number of large economies are modeled independently, namely the U.S., Canada, Russia, Japan, India, and China. Europe also is treated as a single region, although a few countries remain outside the Euro zone. Oceania includes both Australia and New Zealand. These countries are assumed to advance the same exchange rate policies over time. Other countries are aggregated into the remaining regions in the model. Currencies for each of these aggregated regions are chosen based upon the most stable currencies and economies in each region, as well as their involvement in the timber market (Table 1). In South America, for example, Brazil accounts for nearly 70 % of the total value harvested annually. The Brazilian Real is therefore used to simulate exchange rates for all of South America. For Central Asia, there was little data available on exchange rates for the region, so the index of "other Asian" currencies developed by the USDA Economic Research Service (2004) is used.

Figure 1 displays the historical trend and predicted path for the real exchange rates (local currency per US $) of three major timber supply regions, Europe, Canada, and South America. These are based upon the USDA Economic Research Service (2004). The exchange rates used for the 13 regions for the baseline are shown Table 2. The following four exchange rate scenarios are then analyzed:

- Baseline – All exchange rates are constant
- Scenario 1 - Strong US $, 20% increase over 50 years
- Scenario 2 - Strong US $, instantaneous appreciation of 20%
- Scenario 3 - Weak South America, instantaneous depreciation of 20%
- Scenario 4 - Weak South America, 2% decline per year for 50 years

Scenarios 1 and 2 simulate what might happen if the US $ becomes stronger in the future through two separate implementations. First, we assume that the US $ strengthens slowly over time. Specifically, scenario 1 assumes that the US $ strengthens 0.4% per year for 50 years. This change is implemented linearly so the entire change over 50 years is 20% relative to the baseline exchange rates in 2000. The 20% increase is then held constant for the remaining periods in the simulation. Second, we consider an instantaneous 20% increase in the value of the US $ relative to all other currencies. This change is assumed to occur in the first time period, and the change remains constant throughout the entire projection period. Scenarios 3 and 4 examine the influence of persistently weak currencies in South America. Scenario 3 assumes that South America's currency devalues by 20% today relative to all world economies, and maintains this weak currency valuation throughout the projection period. This is consistent with the large annual changes experienced in the late 1990's by several South American economies. Scenario 4 assumes that the South American currency weakens 2% per year for 50 years, and then holds constant. Over the past 30 years, Brazil's currency depreciated an average of 4.4% per year, while Argentina's weakened by an average of 7.7%; thus this rate of change is not unrealistic for a long term scenario analysis.

RESULTS

The baseline results indicate that global timber prices (denominated in 2000 real Southern US softwood log prices) rise from \$114 per m^3 to \$132 per m^3 from 2000 to 2050, an increase of 0.3% per year. Total quantity of timber produced increases only slightly over this time period, from 1.64 billion m^3 to 1.71 billion m^3 per year. Historical timber harvests for a number of major timber producing regions in the model for 1961 to 2000, as well as projections to 2050 for the baseline scenario are shown in Figure 2. Timber production in the United States and Canada are projected to decline over the next half century, while production in Europe expands. Timber production in South America and Oceania, two emerging subtropical plantation regions, steadily increase over time.

In the future, timber supply is projected increasingly to be derived from industrial wood plantations located in sub-tropical regions, including the Southern U.S., Australia, New Zealand, South America, Asia, and Africa. In comparison to many temperate forests that grow at 2 – 5 m^3 per hectare per year, industrial subtropical plantations often grow at 10 – 15 m^3 per hectare per year. The total area of these fast-growing plantations expands from around 70 million hectares currently to around 130 million hectares in 2050. Total wood production increases from about 200 million m^3 per year, or about 13% of total wood supply, to about 700 million m^3, or about 41% of total wood supply by 2050. There is enough productive land in subtropical regions, and land rental costs are low enough, to justify the costs of additional establishments despite relatively modest price increases.

As a result of increasing establishment of fast-growing industrial wood plantations, South America is projected to continue expanding its market share, experiencing an annual increase in production of approximately 0.8% per year over the next 50 years. Under the baseline, most of these increases are derived from harvests in industrial wood plantations. The area of land devoted to plantations in South America is projected to more than double during the coming half century, from 10.7 million hectares to 26.7 million hectares in 2050. Although total harvests increase in the region, baseline harvests from natural tropical and subtropical forests are projected to decline over the next 50 years. Industrial wood plantations are projected to account for as much as 71% of the timber harvested from South America by 2050.

The results of the scenarios on timber production for the world's major timber producing regions are shown in table 4. Average annual timber production over the 50 year period from 2000 – 2050 is shown in the first column. The stronger US $ scenarios, not surprisingly, have a negative effect on timber production in the United States. A

0.4% annual increase in the value of the US $ relative to other currencies could reduce domestic timber production over the next 50 years by 3.8%. The net present value of producer surplus in the U.S. market over the 50 year period, where producer surplus is calculated as the value of timber production less costs, declines by 2.2%. The 12 other timber producing regions have gains in total production and producer surplus. The 20% instantaneous increase in the value of the US $ relative to other currencies reduces US production over the next 50 years by 7.2%. The net present value of producer surplus declines by 8.6%. All other regions experience gains in timber production and increases in producer surplus, with the exception of Europe. South America and Oceania gain the most.

The Southern U.S. is heavily affected by the strong US $ scenarios. The area of pine plantations is expected to increase by about 2.0 million hectares in the baseline over the next 50 years, totaling 14.1 million in 2050. Results suggest that the area devoted to these plantations decreases approximately 2% (0.2 million hectares) relative to the baseline for both scenarios. As a result of the reduction in timberland area, timber production in the US South declines 0.1% relative to the baseline, which translates to a loss of about $500 million in producer surplus. While the overall reduction in timber harvests is greatest in the South, the Northeast and the Great Lakes are hurt the most in percentage terms, as annual harvests in that region decline 8% to 15% relative to the baseline over the period.

The 20% instantaneous devaluation of South America's currency relative to the rest of the world (scenario 3) increases timber production in that region by 6.9%. This amounts to an additional 14 million m^3 of industrial timber harvests per year over the next 50 years. The net present value of producer surplus in South America increases by $17.6 billion. Weaker currency valuations could potentially attract substantial additional foreign direct investment into that region. For scenario 3, the instantaneous reduction in the value of South American currencies relative to the rest of the world has a proportional impact upon harvests in different timber types. Plantation harvests increase by a similar percentage (+6.4%), as harvests in natural tropical and subtropical forests (+7.5%). By 2050, more than 70% of regional harvests were from industrial wood plantations, up from 31% in 2000.

Implementing a 2% per year reduction in the value of South American currencies relative to the rest of the world over a 50 year period (which is a stronger overall change over the next 50 years than scenario 3) suggests a 14.2% increase in timber harvests, or 29 million m^3 per year additional harvesting. This results in additional net present value of producer surplus of $32 billion. Harvests in natural tropical and subtropical forests increase by 29% compared to a 2.4% increase in harvests in plantations. Under the stronger assumptions of this scenario, the proportional change in harvests from natural forests is larger than scenario 3. Inaccessible forests are by definition marginal, so that the reduction in the relative costs of access to these forests has a large effect on harvesting. Weakening currency valuations in South America can have potentially important environmental consequences if these harvests are not conducted in environmentally sound ways.

Increasing harvests in South America causes production in the United States to decline. On average, for every additional 10 - 13 m^3 per year harvested in South America, 1 m^3 less wood is harvested in the United States under these scenarios. The largest effects occur in the Great Lakes and Northeastern states, which experience reductions in timber harvests of 2% - 7% over the period 2000 – 2050 depending on the scenario. All other regions experience a reduction of 1% or less. Costs of production per m^3 of wood harvested tend to be higher in these more northerly regions in the United States, which implies that these regions are most vulnerable to exchange rate policies undertaken by South America.

CONCLUSIONS

This paper examines the influence of exchange rate policies on timber production in the United States and South America. Capital intensive industries, such as forestry, have been shown to be fairly sensitive to exchange rates (Uusivuori and Laaksonen, 2001; Hanninen and Toppinen, 1999). Although in the past couple years the US $ has declined in value relative to many currencies, the historically stated monetary policy of the US government is to pursue a strong US $ relative to other currencies. A strong US $ can weaken the comparative advantage of US industries competing in a global market. In addition to assessing a strong US $, we also consider the effects of weak South American currencies. Historical data indicates that the currencies of countries in South America have depreciated 4 % to 7% per year on average over the past 30 years as these countries have pursued policies that maintain the competitiveness of their products on world markets. These policies appear to have been successful at least to some extent as harvests from South America have increased with continued extraction from inaccessible tropical forests, and the establishment of fast-growing industrial wood plantations on old agricultural land.

To address the effects of exchange rate policies on timber production, we adopt the global timber market model described in Sedjo and Lyon (1990) and Sohngen et al. (1999). The model uses dynamic programming to simulate optimal harvesting, management, and regeneration intensity in 150 timber types throughout the world. Exchange rate policies are introduced by adjusting the cost structure in the model. Depending on the scenario, the costs of harvesting, accessing, regenerating and holding forests in each region are adjusted to account for relative changes in costs caused by changes in exchange rates over time.

In addition to the baseline, four scenarios are considered. Scenarios 1 and 2 examine a strong US $ policy. The first scenario assumes that the US $ gradually becomes stronger by 20% relative to current exchange rates over the next 50 years. The second scenario assumes that the US $ instantaneously becomes stronger in the first period by 20% relative to the current exchange rates. Scenarios 3 and 4 consider weak South American currency valuations. Scenario 3 considers an instantaneous 20% reduction in the value of South American currencies, simulating the devaluations that occurred in the late 1990's. Scenario 4 assumes that the devaluation trends of the past 30 years continue over the next 50 years and then stabilize.

The results indicate that additional strengthening of the US $ relative to the rest of the world could have substantial impacts upon the competitiveness of the US forest products industry. A 20% increase in the value of the dollar would lead to a 4-7% reduction in timber production in the U.S., depending on whether the strengthening occurs earlier rather than later, and a 2– 9% reduction in producer surplus (welfare) in the U.S. timber sector. The Great Lakes and Northeastern U.S. are the most heavily affected regions by the policy. These regions tend to have higher costs and lower growth rates, and therefore are less able to adapt. Pine plantations in the Southern U.S. are expected to continue gaining ground in the U.S. marketplace, but the exchange rate policies do reduce overall establishment over the next 50 years by 200,000 – 300,000 hectares.

The results indicate that if South America continues to pursue weak currency valuations, their timber products sector will benefit. Under scenario 3 (a 20% instantaneous reduction in the value of South American currencies relative to the rest of the world), timber harvests in South America increase by 7% relative to the baseline. Scenario 4 assumes smaller changes in exchange rates over the next half century than observed over the past 30 years, but this scenario stimulates substantial additional harvesting in South America compared to the baseline. Under this scenario, production in South America increases by 14% per year on average over the next half century. Producer surplus for the region increases by $18 billion in scenario 3 and $33 billion in scenario, changing by 7 % and 12 %, respectively. Each additional 10 m^3 of timber harvested in South America reduces production in the United States by 1 m^3 under these exchange rate policies. Portrayed by monetary terms, each 1 m^3 increase in timber production in South American caused by the weak currency policy reduces producer surplus by about $100 in the United States. As with the strong US $ scenarios, production in northern parts of the U.S. is affected most heavily by weak South American currencies.

In addition to potential financial effects, currency policies can influence environmental outcomes. Under scenarios 3 and 4, timber harvests in plantations and natural tropical forests both increase. However, under scenario 4 there are substantial projected increases in harvests in natural tropical forests. This makes sense because these are marginal supply regions and as such any reductions in access costs can have large effects on supply.

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Table 1 - Currencies used for exchange rate in 13 regions

Region	Currency/Currencies used
USA	United States Dollar
Canada	Canadian Dollar
South America	Brazilian Real
Central America	Mexican Peso
Europe	Euro
Russia	Russian Ruble
China	Chinese Yuan
India	Indian Rupee
Oceania	Australian Dollar
SE Asia	Malaysian Ringgit
Central Asia	Index of Central Asian Countries
Japan	Japanese Yen
Africa	South African Rand

Table 2 – Exchange Rates for Baseline Case

	Exchange Rate (Sept '04)* (LC/US$)	Exchange Rate (Baseline) (LC/US$)
US	1.00	1.00
CA	1.31	1.25
SA	2.93	3.33
CENA	11.38	10.09
EU	0.82	0.87
FSU	29.25	25.66
CH	8.27	6.90
IN	46.18	54.12
OC	1.41	1.37
SEA	3.80	3.88
CAS	103.52	114.35
JAP	108.82	98.41
AF	6.64	5.88

*source: US Treasure Dept, 2004

Table 4: Effects of exchange rate policies on annual average production (2000 – 2050).

	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Mm^3/yr	Mm^3/yr	%	Mm^3/yr	%	Mm^3/yr	%	Mm^3/yr	%
U.S.	325.9	313.4	-3.8%	302.4	-7.2%	324.6	-0.4%	323.8	-0.6%
Canada	163.6	163.8	0.1%	164.0	0.2%	163.8	0.1%	162.7	-0.5%
S. America	203.9	204.5	0.3%	205.0	0.5%	218.0	6.9%	233.0	14.2%
C. America	17.5	17.5	0.1%	17.6	0.7%	17.4	-0.4%	17.4	-0.7%
Europe	352.7	354.2	0.4%	350.1	-0.7%	343.7	-2.6%	344.0	-2.5%
Russia	97.8	99.1	1.3%	99.7	1.9%	97.4	-0.4%	97.7	-0.1%
China	137.8	138.8	0.7%	142.5	3.4%	135.4	-1.7%	137.0	-0.6%
India	36.7	36.8	0.2%	36.9	0.5%	36.7	-0.1%	36.6	-0.4%
Oceania	84.2	84.5	0.4%	84.9	0.8%	83.9	-0.4%	83.2	-1.2%
SE Asia	124.3	124.4	0.1%	126.6	1.9%	124.3	0.0%	124.1	-0.1%
Cent. Asia	17.7	17.8	0.5%	17.8	0.5%	17.7	-0.1%	17.6	-0.9%
Japan	59.3	58.9	0.1%	58.9	0.1%	58.9	0.1%	58.8	0.0%
Africa	55.0	55.2	0.5%	55.3	0.6%	54.9	0.1%	54.7	-0.5%
Total	1676.0	1668.8	-0.4%	1661.7	-0.9%	1676.6	0.0%	1690.5	0.9%

Table 5: Effects of exchange rate policies on NPV (r=0.05) producer surplus (2000 – 2150).

	Baseline	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Billion $	Billion $	%	Billion $	%	Billion $	%	Billion $	%
U.S.	531.8	520.0	-2.2%	486.3	-8.6%	532.2	0.1%	528.7	-0.6%
Canada	255.2	255.5	0.1%	256.9	0.7%	255.4	0.1%	253.7	-0.6%
S. America	241.8	242.4	0.2%	243.4	0.7%	259.4	7.3%	274.2	13.4%
C. America	18.8	18.8	0.0%	18.9	0.5%	18.8	0.0%	18.6	-1.1%
Europe	537.6	538.6	0.2%	540.5	0.5%	474.8	-11.7%	533.9	-0.7%
Russia	134.1	134.1	0.0%	135.1	0.8%	134.2	0.1%	133.1	-0.8%
China	160.3	160.8	0.3%	161.3	0.6%	160.3	0.0%	158.9	-0.9%
India	29.1	29.2	0.3%	29.3	0.7%	29.1	0.0%	28.6	-1.7%
Oceania	52.7	53.1	0.8%	53.3	1.1%	52.7	0.0%	51.7	-1.9%
SE Asia	114.8	115.1	0.3%	115.6	0.7%	114.8	0.0%	113.6	-1.0%
Cent. Asia	12.3	12.4	0.8%	12.5	1.6%	12.3	0.0%	12.1	-1.6%
Japan	49.6	49.7	0.2%	50.1	1.0%	49.7	0.2%	49.1	-1.0%
Africa	97.2	97.4	0.2%	97.7	0.5%	97.3	0.1%	96.6	-0.6%
Total	2235.3	2227.1	-0.4%	2200.8	-1.5%	2190.8	-2.0%	2252.8	0.8%

Figure 1 - Historical and projected real exchange rates of selected timber supply regions, 1971-2013

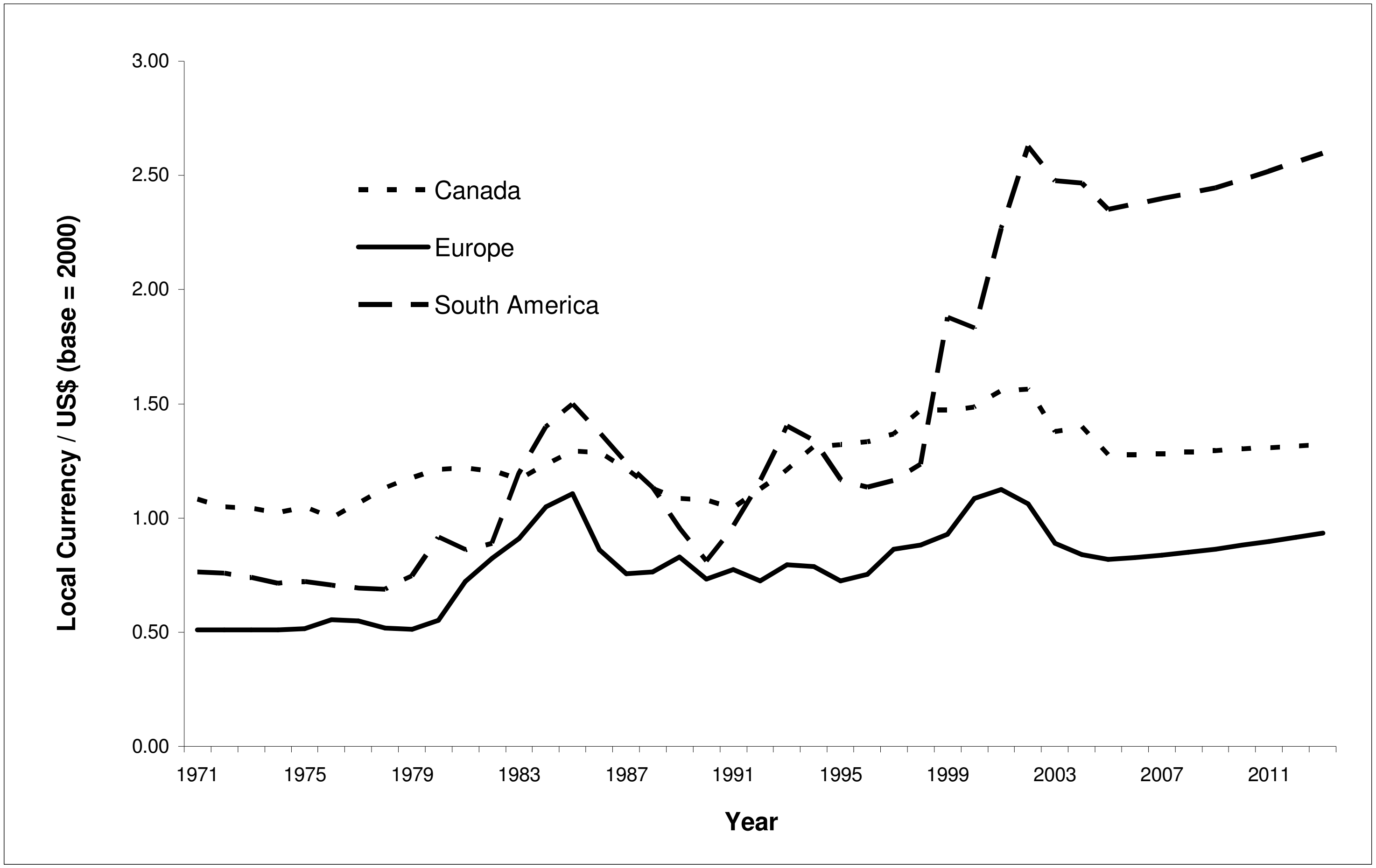

Figure 2 – Historical and projected timber supply by region, 1961-2050