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Estimates from Gravity and CGE Models

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Quantitative assessments of the trade expansion and income gains fostered by a Swiss-US free trade agreement (FTA) require detailed consideration of economic structure and multilateral trade patterns. To carry out this task, we use both gravity and computable general equilibrium (CGE) models. Our gravity model is an augmented version of Rose's (2004) framework,[1] but while Rose analyzed total merchandise trade between multiple partner countries, we examine disaggregated merchandise trade. Our CGE model is the comparative static framework of world trade and economic activity designed by the Global Trade Analysis Project (GTAP). The GTAP model disaggregates world merchandise trade by sectors and also (unlike the gravity model) covers world trade in services. Using two models increases our confidence in the general tenor of the results. While the gravity model is grounded in the empirical tradition of trade analysis, the CGE model rests foremost on theoretical foundations. Hence, each model serves as a check on the other. The basic features and results of our gravity and CGE models are described in the sections that follow. Appendix E contains further technical details.

Before diving into the models, we must emphasize that the results of these exercises do not purport to track the details of the recommendations offered in previous chapters. The CGE model presents "before and after"

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1. Andrew Rose is well known for his contentious questioning of the role of GATT/WTO membership in promoting trade. In this chapter, we cite Rose for his contribution to the technical gravity model and for his database—not for his analysis of the GATT/WTO system.

comparisons, assuming that all trade barriers that have been measured in the model's database are eliminated; it does not attempt the more exacting task of modeling the phaseout, over time, of tariffs, quotas, and other nontariff barriers. Similarly, the gravity model attempts to show what a Swiss-US FTA might accomplish in merchandise trade expansion, based on the average experience of prior FTAs and customs unions. Few of these agreements have achieved the extent of liberalization that we recommend for the Swiss-US FTA. Hence, the model results should not be read as precise forecasts as to what would happen if our recommendations were closely followed. They simply suggest, in broad terms, the quantitative outcome of an FTA.

Gravity Model: Construction and Results

With the proliferation of preferential trading arrangements during the last decade, the gravity model has become a widely utilized tool for analyzing the consequences of bilateral and regional trade agreements.[2] The basic gravity model evaluates thousands of two-way bilateral trade flows, measured in a common currency and adjusted for inflation, against the gravitational mass of explanatory variables describing the characteristics of bilateral trading partners. The core variables are distance and joint real GDP.[3] Most gravity models find that the shorter the distance between countries, and the larger their combined GDP, the greater the two-way trade is between them. Additional explanatory variables are specified as well, and these are of greatest interest: They show how much two-way trade is added or subtracted from the quantity predicted by the basic core variables because of the partners' institutions or policies. For instance, trading partners that share a common border, language, or currency are typically found to enjoy significantly greater mutual trade.

To analyze regional trade agreements, a dichotomous (0,1) explanatory variable—a dummy variable—is introduced to represent preferential arrangements, either individually or on a combined basis. If the coefficient on the dummy variable is positive and significant, then the regional trading arrangement is judged to expand mutual two-way trade between the arrangement members. The extent of trade expansion is usually measured in percentage terms, which can be derived from the estimated coefficient of the dummy variable. Given the log-linear specification of the gravity

2. Greenaway and Milner (2002) provide an excellent introduction to and review of the recent literature on the gravity model and its econometric applications for assessing the trade and other impacts of preferential trading arrangements among regional trading partners.

3. A third "core" variable is joint GDP per capita. A higher joint GDP per capita figure implies a smaller joint population figure (for a given joint GDP level). Less combined population tends to depress the bilateral level of trade; hence, the coefficient on joint GDP per capita is normally negative.

model regression equation,[4] the impact of an FTA on bilateral trade can be computed in percentage terms as 100*[exp(b_{rta}) – 1.00]. In this expression, b_{rta} is the estimated coefficient for the dummy variable representing the presence of a regional trade agreement, and exp(b_{rta}) is the value of the natural number e raised to the exponent b_{rta}. If the coefficient b_{rta} is 0.33, then the value of exp(b_{rta}) is 1.39, and the percentage expansion in trade is estimated as 100*[1.39 – 1.00], which equals 39 percent.

Swiss-US FTA Analytical Framework

We investigate the potential for expanding Swiss-US trade under an FTA following Frankel (1997) and Choi and Schott (2001), among others, using the general framework of the Rose (2004) gravity model. Our approach combines the existing regional trade agreements, and tries to account for the possibility that Swiss-US trade is already significantly greater than the level predicted by the basic explanatory variables of the gravity model in the absence of an FTA.

Our econometric results are based on bilateral trade flows worldwide from 1962 to 1999, compiled by Feenstra and Lipsey (Feenstra et al. 2005) and originally disaggregated according to the 4-digit Standard International Trade Classification (SITC). For the present analysis, the Feenstra-Lipsey trade data were aggregated to the 1-digit SITC level, and deflated by the US consumer price index. They were then concorded, by year and country pair, to the extensive set of explanatory variables compiled for the Rose (2004) gravity model.[5] The core explanatory variables in the Rose dataset include distance between trading partners, joint real GDP, and joint real GDP per capita. The Rose dataset also includes a number of country-specific variables, such as landlocked and island status, language, colonizers, and dates of independence. In all, the dataset constructed for the present analysis, using the augmented Rose gravity model, entails nearly 940,000 observations, covering bilateral trade for about 61,000 combinations of commodities and pairs of trading countries.[6]

To the core explanatory variables are added dummy variables representing bilateral, regional, and other preferential trade arrangements. These include an explanatory variable representing the generalized system of

4. In a log-linear regression, the dependent variable (here, two-way bilateral trade) is expressed in logarithmic terms, whereas some independent variables (notably, the discrete dummy variables) are expressed simply as linear numbers (e.g., 0 or 1), while others (notably, the continuous variables, such as distance or joint GDP) are expressed in logarithmic terms.

5. The complete set of regression variables constructed from the Feenstra-Lipsey and Rose datasets is described in appendix table E.1.

6. Notwithstanding its large size, the combined Feenstra-Lipsey and Rose dataset has some gaps, and excludes Taiwan and some centrally planned economies, because of holes in the two datasets individually.

preferences (GSP).[7] The regional trading arrangement (RTA) variable covers ten regional trade agreements around the world, treated on a combined basis in our analysis.[8] Combining the regional trade agreements allows the model to estimate a single coefficient for the impact of preferential trading arrangements on bilateral trade.

RTAs have, of course, proliferated in recent years. Schott (2004b) calculates that, as of May 2003, some 155 bilateral and regional trade agreements had been notified to the World Trade Organization (WTO) under Article 24 of the General Agreement on Tariffs and Trade (GATT).[9] Accordingly, in accounting for just 10 strong regional trade agreements, the Rose data upon which we rely does not reflect the breadth of recent experience with bilateral and regional trade agreements worldwide. This has uncertain implications for the magnitude of our estimated coefficient of the RTA variable. However, many of the 155 notified agreements are weak, in that they require considerably less than total free trade between the partners. Many others are quite recent—the 1990s were a boom period for FTAs—and their effects need time to flower. For those reasons, Rose's strategy of singling out the 10 strong and well-established RTAs to estimate the trade impact of bilateral and regional free trade has merit.

In our calculations, two Swiss-US trade integration and openness variables are specified in addition to Rose's set of explanatory variables. Actual trade integration between Switzerland and the United States is captured by a dummy variable for trade between the two countries, as if an FTA were already in place. Swiss and US "openness" are measured by separate dummy variables, one for each country. The dummy takes the value of one each time Switzerland (or the United States) is a trading partner with any other country in the world. The estimated coefficients for these "openness" variables suggest the degree to which Swiss (or US) trade with the world is greater or less than the norm established by the core gravity model variables.

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7. The dummy variable is needed to distinguish between countries that receive GSP benefits and those that do not. Under the GSP system, a number of advanced countries extend preferences to less developed countries on a nonreciprocal basis. The GSP programs of major industrial and other countries are monitored by the UN Conference on Trade and Development (UNCTAD), including through a series of manuals describing the individual programs. See UNCTAD (2004a).

8. The Rose dataset includes indicators for the Association of Southeast Asian Nations (ASEAN), European Union (EU), US-Israel FTA, North American Free Trade Agreement (NAFTA), Caribbean Community (Caricom), Agreement on Trade and Commercial Relations between the Government of Australia and the Government of Papua New Guinea (PATCRA), Australia–New Zealand Closer Economic Relations Trade Agreement (ANZCERTA), Central American Common Market (CACM), South Pacific Regional Trade and Economic Cooperation Agreement (SPARTECA), and the Southern Cone Common Market (Mercosur).

9. As of July 2005, the WTO (2005e) features an illustrative list of 32 major regional trade agreements worldwide on its Web site, of which the majority are agreements between small developing countries or newly independent states of Eastern Europe.

Results from the Gravity Model

Tables 8.1 and 8.2 present the regression results for overall trade (SITC 0 through 9) and for trade by major commodity categories: food, beverages, and tobacco (SITC 0 and 1); raw materials (SITC 2 and 4); mineral fuels and lubricants (SITC 3); and manufactures (SITC 5 through 8). Regression coefficients are presented for the overall period 1962–99, and for two subperiods, 1990–99 and 1995–99. The two subperiods correspond to the decade of the 1990s and the post–Uruguay Round period respectively. Finally, the gravity model estimates are presented both with and without the Swiss-US trade integration and openness explanatory variables. As it turns out, the presence or absence of these additional variables makes surprisingly little difference to the other coefficients, including the estimated impact of a regional trade agreement.

The regression results for both total and disaggregated trade mirror the widely reported empirical robustness of the gravity model. In particular, the core explanatory variables, led by distance, joint real GDP, and joint real GDP per capita, bear the anticipated signs and are generally significant at high levels. Thus, for instance, bilateral trade is positively related to the joint GDP of the partner countries, and negatively related to the distance between them. Similarly, countries sharing a common border tend to trade significantly more with one another, whereas landlocked countries tend to trade significantly less than other pairs of countries.

The overall explanatory power of the gravity model using disaggregated bilateral trade data from the Feenstra-Lipsey dataset (R-squared generally about 0.30) is appreciably lower than that found by Rose (2004) using aggregate bilateral trade data (R-squared 0.50–0.60). An exception, however, is the impressive explanatory power of the regression results in table 8.2 for manufactures (R-squared about 0.50).

Gravity model studies by Rose (2004) and most other previous investigators, using aggregate bilateral trade, frequently report estimated coefficients near unity for the RTA variable. By contrast, in our analysis, the estimated coefficients for the RTA variable are generally less than 0.50, except for the post–Uruguay Round period, for which the RTA coefficient estimates generally exceed unity for both total trade and all commodity groups except mineral fuels. A regression coefficient of 0.50 implies that the RTA increases trade between the partners by 65 percent; a regression coefficient of 1.00 implies that the RTA increases trade by 172 percent.

As mentioned in chapter 1, Adams et al. (2003) counter these findings, reporting negative RTA coefficients after using an analytic framework in the spirit of the gravity model and a database that ends in 1997. Indeed, these authors at the Australia Productivity Commission (APC) claim that they find net trade diversion for 12 out of 16 recent RTAs. However, their technique for measuring diversion is poorly explained or justified in the paper, and for reasons explained in appendix E, we do not subscribe to their findings.

Table 8.1 Gravity model estimates for US-Swiss overall (SITC 0 through 9) trade, 1962–99

	1962–99		1990–99		1995–99	
	Without	**With**	**Without**	**With**	**Without**	**With**
Constant	–19.27***	–18.20***	–7.00***	–5.77***	–6.93***	–5.70***
Distance	–0.79***	–0.81***	–0.77***	–0.79***	–0.72***	–0.74***
Joint GDP	0.75***	0.74***	0.53***	0.51***	0.53***	0.51***
Joint GDP per capita	–0.10***	–0.10***	–0.25***	–0.25***	–0.28***	–0.28***
Common language	0.20***	0.13***	0.19***	0.08***	0.22***	0.12***
Common border	0.55***	0.57***	0.96***	0.98***	0.91***	0.93***
Landlocked	–0.19***	–0.25***	–0.50***	–0.62***	–0.53***	–0.66***
Island	0.11***	0.11***	0.34***	0.35***	0.31***	0.33***
Land area	–0.13***	–0.13***	–0.07***	–0.07***	–0.06***	–0.07***
Common colonizer	–0.06**	–0.03	–0.15***	–0.10**	–0.11**	–0.06
Colony	0.75***	0.76***	0.30*	0.30*	0.29	0.29
Ever a colony	1.67***	1.76***	1.00***	1.13***	0.95***	1.08***
Common country	0.22	0.20	–0.65	–0.75	–0.67	–0.77
Currency union	0.80***	0.79***	1.52***	0.66***	1.40***	0.48*
GSP	–0.14***	–0.15***	0.33***	0.26***	0.28***	0.22***
RTAs	0.33***	0.33***	0.32***	0.33***	1.19***	1.21***
US-Swiss trade		0.94*		1.63***		1.57***
US openness		1.46***		1.52***		1.50***
Swiss openness		0.51***		0.94***		1.01***
R-squared	0.40	0.41	0.34	0.35	0.36	0.36
Observations (thousands)	940	940	263	263	146	146
Groups (thousands)	61	61	44	44	41	41

***, **, * indicate that the coefficients are statistically significant at the 99, 95, and 90 percent levels, respectively.

Notes: Estimates are presented both with and without the Swiss-US trade integration and openness explanatory variables. Regressand is log real trade. Distance, GDP, GDP per capita, and land area are measured in log terms. Estimated year effects are not reported. Groups are numbers of country-pair-commodity combinations for which trade exists in the data sample.

Source: Authors' calculations based on generalized least squares estimation of the Rose (2004) gravity model with random effects, using a combined version of Rose (2004) and Feenstra-Lipsey (2005) datasets.

Table 8.2 Gravity model estimates by major commodity categories, 1962–99

	Food, beverages, and tobacco (SITC 0 and 1)						Raw materials (SITC 2 and 4)					
	1962–99		1990–99		1995–99		1962–99		1990–99		1995–99	
	Without	With	Without	With	Without	With	Without	With	Without	With	Without	With
Constant	−13.91***	−12.68***	−3.57***	−2.33***	−3.73***	−2.53***	−17.02***	−16.30***	−6.13***	−5.33***	−6.49***	−5.72***
Distance	−0.65***	−0.67***	−0.60***	−0.63***	−0.57***	−0.59***	−0.57***	−0.58***	−0.48***	−0.49***	−0.43***	−0.45***
Joint GDP	0.60***	0.58***	0.40***	0.38***	0.40***	0.38***	0.69***	0.68***	0.40***	0.39***	0.40***	0.39***
Joint GDP per capita	−0.13***	−0.13***	−0.22***	−0.22***	−0.23***	−0.23***	−0.25***	−0.25***	−0.20***	−0.20***	−0.21***	−0.21***
Common language	0.23***	0.15***	0.20***	0.10*	0.26***	0.16***	−0.01	−0.05	0.03	−0.03	0.06	0.00
Common border	0.60***	0.61***	0.97***	0.99***	0.93***	0.95***	0.37***	0.37***	0.97***	0.98***	0.94***	0.95***
Landlocked	−0.23***	−0.28***	−0.46***	−0.54***	−0.50***	−0.59***	−0.18***	−0.18***	−0.43***	−0.47***	−0.45***	−0.49***
Island	0.09**	0.08**	0.29***	0.30***	0.26***	0.28***	0.10**	0.09**	0.20***	0.21***	0.17***	0.18***
Land area	−0.07***	−0.08***	−0.03***	−0.04***	−0.02	−0.02**	−0.08***	−0.09***	0.01	0.00	0.02*	0.01
Common colonizer	−0.15**	−0.11*	−0.21**	−0.16*	−0.11	−0.07	−0.14**	−0.14**	0.16*	0.18**	0.21**	0.23**
Colony	0.51***	0.52***	0.54	0.54	0.49	0.49	0.44***	0.45***	0.09	0.09	0.27	0.27
Ever a colony	2.05***	2.14***	1.30***	1.41***	1.19***	1.30***	1.15***	1.19***	0.50***	0.57***	0.50***	0.56***
Common country	0.97	0.94	−0.67	−0.78	−0.85	−0.96	−0.20	−0.22	−1.61	−1.67	(dropped)	(dropped)
Currency union	0.83***	0.81***	1.88***	1.00*	1.90***	0.89	0.76***	0.75***	0.56	0.02	0.46	−0.12
GSP	−0.04***	−0.05***	0.42***	0.37***	0.42***	0.36***	−0.21***	−0.22***	0.06	0.04	0.08*	0.05
RTAs	0.55***	0.55***	0.56***	0.57***	1.32***	1.33***	0.36***	0.36***	0.36***	0.37***	1.14***	1.15***
US-Swiss trade		1.27		1.75		1.78		0.35		0.79		0.58
US openness		1.76***		1.56***		1.47***		0.92***		0.87***		0.83***
Swiss openness		0.39***		0.59***		0.67***		−0.09		0.30**		0.31**
R-squared	0.32	0.33	0.28	0.29	0.30	0.31	0.31	0.31	0.27	0.27	0.29	0.29
Observations (thousands)	194	194	53	53	29	29	162	162	43	43	24	24
Groups (thousands)	12	12	9	9	8	8	11	11	7	7	7	7

(table continues next page)

Table 8.2 Gravity model estimates by major commodity categories, 1962–99 *(continued)*

	Mineral fuels and lubricants (SITC 3)						Manufactures (SITC 5 through 8)					
	1962–99		1990–99		1995–99		1962–99		1990–99		1995–99	
	Without	With	Without	With	Without	With	Without	With	Without	With	Without	With
Constant	−11.26***	−10.57***	−3.35***	−2.25***	−3.52***	−2.40***	−25.04***	−23.96***	−11.08***	−9.85***	−10.60***	−9.33***
Distance	−1.02***	−1.03***	−0.82***	−0.84***	−0.80***	−0.83***	−0.98***	−1.00***	−1.03***	−1.05***	−0.98***	−1.00***
Joint GDP	0.31***	0.31***	0.27***	0.26***	0.29***	0.28***	0.98***	0.96***	0.73***	0.71***	0.72***	0.70***
Joint GDP per capita	0.41***	0.41***	0.03	0.02	−0.05	−0.05*	−0.12***	−0.13***	−0.32***	−0.33***	−0.37***	−0.37***
Common language	−0.25***	−0.28***	0.01	−0.07	0.05	−0.03	0.36***	0.27***	0.25***	0.14***	0.28***	0.17***
Common border	0.54***	0.53***	1.13***	1.15***	1.21***	1.22***	0.66***	0.68***	1.09***	1.10***	0.99***	0.99***
Landlocked	−1.34***	−1.21***	−1.28***	−1.34***	−1.30***	−1.37***	−0.07***	−0.21***	−0.50***	−0.66***	−0.56***	−0.72***
Island	0.50***	0.47***	0.58***	0.58***	0.65***	0.65***	0.02***	0.03	0.35***	0.37***	0.32***	0.35***
Land area	0.18***	0.17***	0.16***	0.15***	0.16***	0.15***	−0.24***	−0.23***	−0.15***	−0.15***	−0.15***	−0.15**
Common colonizer	0.74***	0.71***	0.79***	0.81***	1.11***	1.13***	−0.12***	−0.06*	−0.32***	−0.26***	−0.32***	−0.25***
Colony	0.69***	0.69***	−0.08	−0.08	0.32	0.32	0.82***	0.83***	0.39	0.39	0.33	0.33
Ever a colony	0.97***	0.98***	0.20	0.28	0.23	0.32	2.06***	2.16***	1.47***	1.62***	1.40***	1.54***
Common country	−0.75	−0.80	−1.10	−1.19	−1.43	−1.52	0.46***	0.47	−0.81	−0.90	−1.05	−1.15
Currency union	0.70***	0.69***	0.66	0.05	1.05	0.42	0.66***	0.65***	1.67***	0.75**	1.32***	0.33
GSP	−0.37***	−0.37***	−0.30***	−0.33***	−0.31***	−0.36***	−0.13***	−0.14***	0.54***	0.45***	0.46***	0.37***
RTAs	−0.28***	−0.28***	0.18**	0.18**	0.59***	0.60***	0.37***	0.37***	0.29***	0.31***	1.45***	1.48***
US-Swiss trade		1.43		−0.18		0.10	0.64		2.48***	1.67***	2.44***	
US openness		0.91***		1.10***		1.12***		1.51***		1.32***		1.71***
Swiss openness		−0.95***		0.26		0.33		1.34***				1.37***
R-squared	0.33	0.33	0.26	0.27	0.27	0.28	0.57	0.58	0.50	0.51	0.52	0.53
Observations (thousands)	61	61	17	17	9	9	461	461	133	133	74	74
Groups (thousands)	5	5	3	3	3	3	28	28	21	21	20	20

***, **, * indicate that the coefficients are statistically significant at the 99, 95, and 90 percent levels, respectively.

Note: Estimates are presented both with and without the Swiss-US trade integration openness explanatory variables. Regressand is log real trade. Distance, GDP, GDP per capita, and land area are measured in log terms. Estimated year effects are not reported. Groups are numbers of country-pair/commodity combinations for which trade exists in the data sample.

Source: Authors' calculations based on generalized least squares estimation of the Rose (2004) gravity model with random effects, using a combined version of Rose (2004) and Feenstra-Lipsey (2005) datasets.

The regression coefficients for the US openness variable are always greater than those for the Swiss openness variable, suggesting that trade resistance forces are stronger in Switzerland than they are in the United States. Estimated coefficients for the Swiss-US trade integration variable on a sector-by-sector basis (table 8.2) generally have high positive values, suggesting that bilateral trade already exceeds the international norm. However, the coefficient is only significant for trade in manufactures in the 1990s. These results tend to suggest that US exports to Switzerland would expand more than Swiss exports to the United States under a Swiss-US FTA. They also suggest that agriculture is a prime candidate for trade expansion in both directions, probably because both countries currently have high levels of protection in place. Other evidence, reported shortly, suggests that there is also considerable room for expanded manufactures trade between Switzerland and the United States.

Table 8.3 reports the trade expansion effects implied by the various coefficient estimates for the RTA variables in tables 8.1 and 8.2.[10] The simple average column gives equal weight to the coefficients estimated for each of the overlapping periods. Based on the simple average percentage expansion for total trade (104 percent) and the four sectors taken together (102 percent), it appears that overall Swiss-US merchandise trade might expand, under an FTA, by a central estimate of about 100 percent, holding all other factors constant.[11] Both agriculture and manufactures two-way trade might expand by about 140 percent. Predicted expansion of Swiss-US trade in manufactures by more than 100 percent may seem implausible, given the relative openness of both Switzerland and the United States. However, a leap in bilateral foreign direct investment (FDI) could induce a great deal of bilateral trade expansion, as chapter 7 suggests.[12]

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10. The figures in the tabulation are based on the regressions that include the dummy variables for Swiss-US trade integration and openness. However, as mentioned, the dummy variables make very little difference to the RTA coefficients.

11. Results of the CGE model, presented in this chapter, suggest that a Swiss-US FTA could lead to an expansion in bilateral trade in services of about 10 percent. However, based on Ceglowski (2005) estimates of the correlation coefficient between expansion in merchandise trade and in services trade, and the reported estimates of merchandise trade expansion, it is possible that a Swiss-US FTA could lead to as much as a 60 to 70 percent increase in bilateral trade in services.

12. Ignoring the other coefficients, and focusing only on post–Uruguay Round estimation results, suggests that overall Swiss-US trade might grow by 235 percent, led by expansion of manufactures (nearly 340 percent) and agriculture (nearly 280 percent). These results do seem implausible. However, given the array of hidden barriers to manufactures trade as well as overt barriers to agricultural trade, bilateral trade expansion could conceivably exceed 100 percent.

Table 8.3 Implied trade expansion effects (percent)

Category	1962–99	1990–99	1995–99	Simple average
Total trade (SITC 0–9)	39	39	235	104
Disaggregated trade				
Agriculture (SITC 0 and 1)	73	76	278	142
Raw material (SITC 2 and 4)	43	45	215	101
Fuels (SITC 3)	–25	20	82	26
Manufactured goods (SITC 5–8)	45	36	339	140
Simple average[a]	34	44	229	102

SITC = Standard International Trade Classification

a. The simple average excludes the estimate for total trade (SITC 0–9).

Source: Authors' calculations.

CGE Model: Construction and Results

CGE models are based on general equilibrium principles; they are built to turn abstract theories into practical tools. A number of features distinguish them from other widely used frameworks for trade policy analysis, especially gravity models. In particular, the actions of economic agents are modeled explicitly through utility- and profit-maximizing assumptions, while economy-wide resource and expenditure constraints are rigorously enforced. Because they gather markets into a single system, CGE techniques effectively capture feedback and flow-through effects induced by policy changes. Economic distortions often have repercussions beyond the sector in which they occur, which CGE models are designed to capture. They are particularly well-suited to examining FTAs, under which multisector liberalization is undertaken in at least two countries simultaneously and adverse consequences of discriminatory preferences may well arise (Panagariya 2000).

Against these significant advantages, CGE models are highly data-intensive, and subject to several uncertainties. How should equations be specified? What parameters should be used? How should the FTA experiment be designed? Because CGE results are sensitive to these decisions, they should be viewed cautiously. Our CGE model is the GTAP framework, a publicly available and widely adopted model. Multiregion and multisector, it assumes perfect competition and constant returns to scale. These assumptions are very strong, and in practice, tend to apply best to homogeneous goods and not so well to services, which are more heterogeneous and often entail large fixed costs. Other CGE frameworks assume that countries enjoy increasing returns to scale as they specialize, and that monopolistic markups are eroded by trade liberalization. Such models may also assume that freer trade spurs investment and productivity. Some also incorporate

dynamic effects, such as fostered innovation due to greater competition. These additional assumptions typically result in significantly larger calculated trade and economic gains as a consequence of removing barriers. By contrast, the results reported here, using a comparative statics framework, are very conservative and may severely underestimate the benefits of an FTA—most notably in services, which command more than 70 percent of GDP in both the US and Switzerland, and for which products are in practice differentiated and knowledge-intensive. Accordingly, the expected gains of a Swiss-US FTA should come from returns to scale, competitive erosion of markup margins, and dynamic innovation. The GTAP model, however, does not capture these effects.

Experimental Design

The proposed FTA between Switzerland and the United States is first simulated independently of the existence of other FTAs. The results thus reflect the estimated effect of the proposal in isolation from any liberalization that occurred after the reference year for the GTAP6 database (2001), or that might be forthcoming. For services trade, the base year for the tariff equivalent values used in the analysis is 1996, reflecting barriers to trade in services as reported by Dee, Hanslow, and Phamduc (2003).

We then consider an all-partners experiment, in which the proposed Swiss-US FTA is implemented simultaneously with other, newer US FTAs—those ratified after the GTAP6 database—and prospective US FTAs that might come in force by the end of 2006. The newer US FTAs are those with Chile, Australia, Singapore, and Morocco; the prospective FTAs, apart from the Swiss-US FTA, are the Central American Free Trade Agreement (CAFTA) as well as FTAs with Thailand and the Southern African Customs Union (SACU).

In all cases, arrangements are assumed to be implemented "clean," meaning that all participating economies eventually reduce their import tariffs to zero on a bilateral preferential basis. Services trade barriers are also eliminated.[13] However, all other tariffs and barriers, such as those applied to nonparticipating economies, are left in place. In other words, possible liberalization negotiated in the WTO Doha Development Round is not taken into consideration. Moreover, in the experiment with all free trade areas, it is assumed that the FTAs are implemented only with the United States. Preferential liberalization among proposed partner regions is not considered.

As an additional benchmark for the implications of bilateral FTAs, beyond the status quo benchmark of the CGE model baseline, we also consider unilateral trade reform scenarios for Switzerland and the United States. In these scenarios, each economy is assumed to unilaterally remove

13. Estimates of barriers to services are those reported by Dee, Hanslow, and Phamduc (2003), which reflects barriers as of 1996.

all tariffs on a nondiscriminatory basis, thereby indicating the extent to which an FTA either improves upon, or falls short of, the usual textbook optimum of free trade.

All of the simulations are run as exercises in comparative statics. This entails "before" and "after" pictures, allowing all of the agreed bilateral liberalization to take place and all industries to adjust, but with no attempt to profile the time path of adjustment. Factor market "closure" conditions allow full mobility of capital and labor across domestic industries; in other words, all capital and labor, both skilled and unskilled, are assumed to be fully employed once the adjustment process is complete.[14] The implicit time frame is the long run, typically regarded as an adjustment period of about 10 years. However, the adjustment path is not directly modeled. Land is treated as imperfectly mobile across agricultural activities, while other natural resources are assumed to be committed to individual industries as specific factors.

Results from the CGE Model

Table 8.4 presents estimates of the overall effect of the proposed agreement. The model predicts fairly dramatic increases in the volume of bilateral trade between the United States and Switzerland, with US exports to Switzerland increasing by 32 percent and Swiss exports to the United States increasing by approximately 12 percent. One reason for the dramatic increase in US exports is that Swiss imports from other countries may decline, once US firms enjoy a preferential tariff structure. This effect, known as trade diversion, seems quite strong in Switzerland's case.[15] Swiss tariffs on agriculture are high, and the United States would become a preferred supplier alongside the European Union. The overall welfare effects of the agreement are estimated to be small for both economies, and positive for Switzerland.[16]

The unilateral benchmark results indicate somewhat why the welfare outcomes are what they are. The United States is already a very open economy, and hence, has little to gain in efficiency from further liberalization. In fact, it loses in welfare terms from unilateral reform, due to shifts in

14. An alternative assumption, consistent with the same results, is that unemployment rates for labor and capital remain the same before and after full adjustment.

15. Swiss trade diversion is also reflected in the significant drop in Swiss tariff revenues, shown in the third section of table 8.4, and in the adverse terms-of-trade shift (discussed below).

16. The welfare effects presented in table 8.4 are measured as the equivalent variation (EV) in income. This is essentially the change in household income that equals the proposed change, at constant consumer prices.

Table 8.4 CGE changes in key variables, Swiss-US FTA

	United States			Switzerland		
	Initial value (millions of dollars)	**Free trade area** (percent change or millions of dollars)	**Unilateral benchmark** (percent change or millions of dollars)	**Initial value** (millions of dollars)	**Free trade area** (percent change or millions of dollars)	**Unilateral benchmark** (percent change or millions of dollars)
Total import value	1,289,855	0.1	2.9	97,559	1.9	3.1
From partner	14,909	12.3	2.1	10,981	32.4	5.5
From rest of world	1,274,946	–0.1	2.9	86,578	–2.0	2.8
Total export value	881,759	0.6	4.4	107,007	1.0	1.9
To partner	10,811	32.0	5.7	14,683	12.2	3.5
To rest of world	870,948	0.2	4.4	92,324	–0.8	1.6
Tariff revenue	19,946	–192	–19,946	2,445	–821	–2,445
From partner	157	–157	–157	324	–324	–324
From rest of world	19,789	–35	–19,789	2,120	–496	–2,120
Welfare as percent of GDP		0.0	–0.1		0.0	0.1
Total export value	—	–94	–11,510	—	106	186
Allocative efficiency	—	–145	1,716	—	–30	33
Terms of trade	—	51	–13,226	—	135	154

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

terms of trade, though by only a small fraction of GDP.[17] Recall also that the GTAP model results do not incorporate returns to scale, or competitive or dynamic effects—and all of these are important, especially for the services sector. Finally, since the Swiss market is relatively small, there are few opportunities to counter adverse terms-of-trade shifts with increased market access. For Switzerland, the gains from unilateral liberalization are larger, reflecting higher protection levels in a few key markets and much smaller adverse terms-of-trade effects.

It should be emphasized that alternative modeling techniques suggest much larger GDP gains from expanded Swiss-US trade than the gains calculated by our static CGE analysis using the GTAP framework. Based on table 8.4, Swiss-US bilateral trade might increase by $5.3 billion in the wake of a Swiss-US FTA.[18] Research reported elsewhere (Bradford et al. 2005), using a variety of alternative techniques, suggests that annual GDP gains to each partner would amount to about 20 percent of the expanded trade, or about $1.1 billion annually.[19] These gains reflect the adoption of improved production methods in response to competitive pressures, the exit of less efficient firms, scale and network economies, reduced markup margins, more intense use of imported inputs, and greater variety in the menu of available goods and services. For the United States, as a percentage of GDP, the annual gains calculated by the static GTAP model are very small, but for Switzerland, they represent about 0.5 percent in GDP.

The welfare effects of the Swiss-US FTA on third countries are presented in more detail in table 8.5. Most other economies suffer very small welfare losses because of the FTA, though China incurs the largest adverse effects. Preference dilution—the phenomenon whereby existing FTA partners lose the benefits of preferential access to the Swiss or US market when Switzerland enters into free trade with the United States—does not seem to be significant for either NAFTA or EFTA members, though the European Union sees a slight effect. As a proportion of regional GDP, all welfare effects on nonmembers are very minor. Under unilateral reform, by contrast, nonmembers generally benefit.

The CGE model predicts that Switzerland would gain twice as much in GDP terms if the United States unilaterally abolished its barriers with all

17. This result for US unilateral trade liberalization is commonly found in CGE models that use the GTAP framework. It emphasizes the importance of concerted, reciprocal trade liberalization for a large economy, such as the United States, to avoid adverse terms-of-trade effects. For a smaller economy, such as Switzerland, reciprocal trade liberalization is not so essential to avoid an adverse movement in terms of trade.

18. In addition, the United States would slightly expand its imports from the rest of the world, but Switzerland would slightly contract its imports.

19. This rough rule of thumb finds strong support in the econometric literature, but of course counterexamples can be cited in which GDP gains are not related in a simple fashion to trade expansion. On the other hand, GDP gains could be much larger than the figures cited in the text if two-way trade doubled as the gravity model calculations suggest.

Table 8.5 CGE changes in net welfare by region, Swiss-US FTA

Country	Initial GDP (billions of dollars)	Free trade area			Unilateral benchmark					
					United States			Switzerland		
		Total	Allocative efficiency	Terms of trade	Total	Allocative efficiency	Terms of trade	Total	Allocative efficiency	Terms of trade
		(millions of dollars)			(millions of dollars)			(millions of dollars)		
Australia	350.4	9	5	4	224	1	223	9	0	9
Brazil	490.9	18	10	8	389	107	283	102	13	89
Central America	102.2	–3	–1	–2	757	320	437	–6	0	–6
Chile	65.0	1	1	0	58	1	57	1	–1	2
China	1,061.6	–21	8	–29	3,060	795	2,266	51	–18	68
Eastern Europe	817.2	9	19	–9	493	22	471	144	–8	152
European Union	7,781.7	–16	204	–220	4,925	253	4,672	171	11	161
Hong Kong	165.3	7	3	4	–4	–63	59	–27	–3	–24
Japan	4,027.3	90	17	73	2,019	352	1,666	47	9	37
Morocco	32.9	–1	0	–1	21	7	14	82	6	75
New Zealand	49.8	–4	1	–5	73	0	74	5	–1	6
Rest of EFTA	198.6	5	3	1	143	–10	153	7	0	7
Rest of South America	693.0	22	12	10	545	118	427	10	0	10
SACU	10.0	–1	0	–1	28	2	26	0	0	0
South Korea	408.6	–3	2	–6	848	55	793	4	–6	10
Switzerland	242.5	106	–30	135	204	–5	208	207	1,146	–939
Taiwan	275.9	–10	1	–11	623	4	619	1	–2	3
Rest of world	1,939.7	–2	28	–31	1,566	100	1,466	174	77	98

(table continues next page)

Table 8.5 CGE changes in net welfare by region, Swiss-US FTA *(continued)*

		Free trade area			Unilateral benchmark					
					United States			Switzerland		
Country	**Initial GDP** (billions of dollars)	**Total**	**Allocative efficiency**	**Terms of trade**	**Total**	**Allocative efficiency**	**Terms of trade**	**Total**	**Allocative efficiency**	**Terms of trade**
		(millions of dollars)			(millions of dollars)			(millions of dollars)		
Indonesia	140.6	–6	0	–6	323	–69	392	11	–2	13
Malaysia	86.9	–5	4	–9	150	–52	203	4	–3	7
Philippines	67.4	–4	–3	–2	246	68	178	4	3	0
Singapore	84.8	1	2	–1	8	–22	30	–6	–2	–3
Thailand	111.7	–8	0	–8	280	–48	328	4	–1	5
Vietnam	31.2	–4	0	–4	178	92	86	12	4	8
All ASEAN	522.6	–26			1,186			28		
Canada	703.8	54	12	42	–844	37	–881	29	4	25
Mexico	599.3	0	–15	15	–1,175	–101	–1,074	28	–3	31
United States	9,987.0	–94	–145	51	–11,510	1,716	–13,226	186	33	154
All NAFTA	11,290.1	–40			–13,529			244		
All world	30,525.3	138			3,630			1,254		

EFTA = European Free Trade Association
SACU = Southern African Customs Union

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

countries instead of just entering an FTA with Switzerland. This result presumably reflects the spur to global growth that would result from unilateral US trade reform. While unilateral reform is not in the cards, if a Swiss-US FTA is implemented, the calculation suggests that Switzerland can be relaxed about further US liberalization in the Doha Round or other trade contexts.

Table 8.6 contains details on the change in the pattern of overall trade by region. The effects of the Swiss-US FTA on nonmember exports to the United States are very small. For Switzerland, however, the effects are more significant and consistently negative, especially for Australia, New Zealand, China, and the members of the Association of Southeast Asian Nations (ASEAN).

CGE models also allow us to predict which sectors are most likely to be affected by the proposed agreement. The results of the analysis appear in tables 8.7 and 8.8. Table 8.7 presents the estimated changes in bilateral and total exports by economic sector. The simulations predict some very large gains in US exports of agricultural products, including grains, oil seeds, animal products, dairy, and other manufactures. Dairy in particular could see extremely large gains, but from a very small base of only $1.8 million in 2001. These results reflect very high protection levels for Switzerland in 2001 in the GTAP6 database: 34 percent for grains, 21 percent for oil seeds, 101 percent for animal products, and 108 percent for dairy. Other manufactures—excluding motor vehicles, machinery and electronic equipment—could see export gains of 73 percent.[20] From the perspective of overall US trade, only the Swiss tariff changes in raw animal products, dairy products, and other manufactures are large enough to have a significant impact on US bilateral exports.

For Switzerland, the bilateral export gains are much smaller, but still very significant in dairy, textiles, metal products, and some agricultural products. Reflecting the comparatively large role that the United States plays in Switzerland's bilateral trade profile, these translate into significant overall trade expansion in the areas of raw animal products, dairy products, and certain manufactures.

The predicted changes in bilateral trade in services are positive but relatively small, at 10 percent for US exports to Switzerland and 13 percent for Swiss exports to the United States.[21] Moreover, total US exports of services are in fact predicted to decline, indicating that the increase in US exports to Switzerland represents a diversion. There are three model-related

20. Based on the data in appendix E, we have assumed that the Swiss tariff barrier for this category is 11 percent. This is well below the implausibly high figure in the GTAP6 database, namely 155 percent.

21. These estimates are very conservative. Using a similar gravity model approach for bilateral services trade as the model presented earlier in the chapter for merchandise trade, Ceglowski (2005) estimates that trade in services among partners to a regional trade agreement is 38 percent higher than among other nonmember trading partners. Moreover, she also finds a 0.6 to 0.7 correlation coefficient between increased trade in services and trade in goods. Based on our two estimates for increased merchandise trade (100 percent from the gravity model and 20 percent from the CGE model) the upper and lower estimates for trade creation in services could range from 14 to 70 percent.

Table 8.6 CGE changes in the regional pattern of exports, Swiss-US FTA

	Initial value (billions of dollars)			Free trade area (percent change)			Unilateral benchmark (percent change)			
							United States		Switzerland	
Country/region/group	Total	To the United States	To Switzerland	Total	To the United States	To Switzerland	Total	To the United States	Total	To Switzerland
Australia	72.3	8.6	0.4	0.0	0.0	–6.1	0.3	4.7	0.0	2.2
Brazil	67.8	16.0	0.5	–0.1	–0.1	–3.6	0.3	4.4	0.0	88.3
Central America	34.1	13.4	0.3	0.0	0.0	–5.7	1.7	11.6	0.0	–0.7
Chile	21.7	4.0	0.1	0.0	0.0	–3.4	0.2	2.3	0.0	6.2
China	379.6	108.4	1.5	0.0	–0.1	–3.7	1.2	9.8	0.0	22.3
Eastern Europe	340.8	24.3	5.8	0.0	–0.1	–0.7	0.2	1.1	0.1	13.3
European Union	2,477.9	287.1	62.6	0.0	–0.1	–1.8	0.3	3.2	0.0	0.0
Hong Kong	98.2	20.4	0.9	0.0	0.0	–4.6	0.6	7.5	0.0	2.7
Japan	448.8	123.9	2.0	–0.1	–0.3	–0.7	0.4	4.3	0.0	5.8
Morocco	11.2	1.1	0.1	0.0	0.0	–4.0	0.3	1.9	0.3	300.2
New Zealand	18.1	2.8	0.1	0.0	–0.1	–20.9	0.4	5.9	0.0	33.6
Rest of EFTA	66.4	7.8	0.4	0.0	0.0	–3.3	0.0	0.3	0.0	–4.5
Rest of South America	119.7	33.5	1.3	0.0	0.0	–1.9	0.4	2.7	0.0	0.9

SACU	6.2	0.5	0.0	0.0	0.0	−7.9	0.9	24.4	0.0	−6.6
South Korea	175.4	37.2	0.6	0.0	−0.1	−0.7	0.6	6.3	0.0	3.1
Switzerland	107.0	14.7	—	1.0	12.2	—	0.3	2.1	1.9	0.0
Taiwan	135.7	36.1	0.5	0.0	−0.1	−0.6	0.6	5.2	0.0	0.7
Rest of world	507.5	99.8	3.5	0.0	0.0	−4.9	0.5	2.7	0.0	2.9
Indonesia	68.0	11.4	0.2	0.0	−0.1	−1.3	1.0	13.2	0.0	6.9
Malaysia	124.4	24.0	0.3	0.0	−0.1	−2.2	0.4	3.0	0.0	1.6
Philippines	37.9	11.5	0.1	0.0	−0.1	−4.2	0.1	5.4	0.0	−1.9
Singapore	110.4	17.8	0.5	0.0	−0.1	−7.8	0.2	1.0	0.0	5.1
Thailand	79.4	17.2	0.5	0.0	−0.1	−2.9	0.3	6.3	0.0	4.8
Vietnam	15.3	1.4	0.1	0.0	0.0	−1.5	0.2	8.3	0.0	−1.5
All ASEAN	435.3	83.4	1.7	0.0	−0.1	−4.0	0.4	5.1	0.0	3.7
Canada	265.3	198.2	0.6	0.0	0.0	−3.5	−0.9	−2.2	0.0	4.1
Mexico	164.3	129.5	0.5	0.0	0.0	−2.6	−0.5	−1.8	0.0	22.3
United States	881.8	—	10.8	0.6	—	32.0	4.4	—	0.0	5.4
All NAFTA	1,311.4	327.8	11.9	0.4	0.0	28.9	2.7	−2.0	0.0	6.0
All world	6,835.1	1,250.9	94.1	0.1	0.1	1.9	0.9	2.8	0.1	3.1

EFTA = European Free Trade Association
SACU = Southern African Customs Union

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

Table 8.7 CGE changes in the sectoral pattern of exports, Swiss-US FTA

	United States					Switzerland				
	Initial value (millions of dollars)		Free trade area (percent change)		Total : Unilateral benchmark (percent change)	Initial value (millions of dollars)		Free trade area (percent change)		Total : Unilateral benchmark (percent change)
Sector	Total	To Switzerland	Total	To Switzerland		Total	To the United States	Total	To the United States	
Grains	9,638	8	0.1	401.4	1.5	64	0	6.3	7.0	72.9
Oil seeds	5,698	11	0.2	115.1	1.3	9	0	4.8	5.1	27.7
Plant-based fibers	2,209	4	–0.1	0.4	5.4	50	0	1.4	5.4	9.0
Other crops	8,062	57	0.1	21.4	2.1	205	7	3.8	33.9	30.8
Raw animal products	12,287	32	7.6	2,880.1	2.0	118	8	24.6	30.8	111.2
Wool	9	0	–0.3	–1.3	13.5	3	0	2.5	21.3	19.6
Forestry	1,254	3	0.0	2.8	1.2	129	0	0.3	13.6	1.3
Coal, oil, and gas	4,246	2	–0.1	10.3	2.9	57	0	0.2	1.8	4.4
Dairy products	802	2	26.5	11,799.7	2.5	361	35	41.3	349.8	31.1
Other food products	19,615	123	0.8	105.1	1.2	1,888	102	2.4	29.6	13.7

Textiles and clothing	19,337	65	0.5	60.7	8.8	2,180	172	6.1	82.7	−0.1
Wood products	8,212	17	0.3	12.0	1.7	823	27	0.0	4.3	−1.0
Paper products	20,031	88	0.4	26.6	0.9	2,001	78	−0.4	1.0	−1.5
Chemicals	117,946	1,451	0.3	3.6	1.5	24,126	2,797	0.4	11.4	−1.8
Ferrous metals	6,932	36	0.3	8.2	0.9	994	36	−0.2	9.5	−1.6
Nonferrous metals	11,379	223	0.3	1.1	2.7	5,626	465	−0.4	3.3	−1.7
Metal products	14,857	52	0.4	16.6	1.3	2,823	276	1.6	22.6	−1.9
Motor vehicles	108,533	597	0.3	3.9	1.4	2,068	336	0.1	3.2	−1.7
Electronic equipment	110,550	514	0.4	1.5	2.9	2,901	408	−1.0	−0.4	−2.7
Machinery and equipment	165,096	1,241	0.5	3.8	2.5	30,230	3,939	0.3	8.1	−2.3
Other manufactures	15,588	2,029	9.8	73.1	3.6	4,739	659	1.8	10.8	1.4
Nontraded services	4,083	16	0.4	0.9	1.8	2,715	20	−0.8	−1.1	−1.7
Traded services	215,394	4,240	−0.1	10.2	11.2	22,898	5,316	2.1	13.1	12.2

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

Table 8.8 CGE changes in the sectoral pattern of production, Swiss-US FTA (percent change in volume)

Sector	United States			Switzerland		
	Initial value (millions of dollars)	**Free trade area** (percent change)	**Unilateral benchmark** (percent change)	**Initial value** (millions of dollars)	**Free trade area** (percent change)	**Unilateral benchmark** (percent change)
Grains	27,807	0.2	0.4	259	−0.8	−28.1
Oil seeds	12,589	0.1	0.4	36	−1.2	−7.1
Plant-based fibers	7,202	0.0	−1.1	70	1.4	9.3
Other crops	58,248	0.6	−0.2	1,028	−6.4	−19.0
Raw animal products	249,552	0.0	−0.2	7,362	1.6	−7.6
Wool	121	0.4	−0.5	3	2.9	19.8
Forestry	17,760	0.1	−0.1	678	−0.1	−1.2
Coal, oil and gas	112,617	0.1	0.2	1,237	−0.1	−0.3
Dairy products	83,610	0.3	−1.3	3,516	2.9	−2.1
Other food products	499,685	0.1	−0.2	10,526	0.0	−0.4
Textiles and clothing	267,866	0.2	−9.0	3,765	3.6	−1.4
Wood products	225,048	0.1	0.1	1,565	−0.5	−2.9
Paper products	388,380	0.1	0.0	10,208	−0.4	−0.8
Chemicals	980,688	0.1	−0.7	38,495	−0.1	−2.0
Ferrous metals	141,164	0.2	−0.3	7,262	0.0	−1.8
Nonferrous metals	109,351	0.2	−0.1	8,966	−0.5	−2.1
Metal products	286,796	0.1	−0.4	5,467	0.8	−1.9
Motor vehicles	654,361	0.1	−0.2	15,920	0.5	−0.4
Electronic equipment	347,619	0.2	1.4	5,775	−0.7	−2.1
Machinery and equipment	779,360	0.2	0.1	36,836	0.0	−2.5
Other manufactures	63,740	2.5	0.3	7,813	−1.8	−6.5
Nontraded services	2,476,501	0.0	−0.1	51,699	0.5	0.3
Traded services	9,981,558	−0.1	0.2	208,258	0.0	1.4

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

explanations for these small and counterintuitive changes. The first is that the trade flow barriers estimated by Dee, Hanslow, and Phamduc (2003) are relatively low, about 5 percent on an ad valorem–equivalent basis. The second is that certain types of barriers, such as taxes on interest, dividends, and sales, are not region-specific in the GTAP model. The third and perhaps most important possibility is that barriers to trade in services limit trade flows to a greater extent than is modeled in the GTAP framework. Trade barriers in services may hinder firms from investing in foreign market (GATS mode 3); reducing them could spur FDI in the affected service sectors and beneficially enhance competitive pressures. The GTAP model does not capture such positive productivity effects. Hence, the applied general equilibrium analysis reported here very likely understates the potential for expanded bilateral services trade under a Swiss-US FTA.

Table 8.8 contains the estimated changes in output by sector. These figures are useful for understanding the extent of structural adjustment that the agreement might require. In the United States, the only sector affected by the proposed FTA, beyond a marginal extent, is the "other manufactures" sector, which enjoys an expansion of 2.5 percent. This finding suggests that US adjustments in response to the Swiss-US FTA would be negligible.

In Switzerland, the adjustment burdens are likely to be more substantial, with significant output declines predicted in manufacturing and crops. However, output gains are estimated in dairy, textiles, and apparel. Overall, while Swiss adjustments are much greater than those predicted for the United States, the burden seems to be manageable—especially when the bilateral FTA is compared with the unilateral benchmark, for which the required adjustments are substantial (table 8.8).

A final issue of concern is how the benefits of the proposed FTA are likely to be spread across different members of society. The GTAP framework deals with this issue in the Ricardian tradition, by estimating changes in the rewards to the primary factors (capital, labor, and land) used in the production process. The estimated percentage changes in real factor rewards are presented in table 8.9. In the United States, all effects are relatively minor. In Switzerland, important changes are predicted—in particular, a decline in the returns to land and natural resources, suggesting that agricultural households are likely to come under pressure from increased US agricultural exports, although again by a much smaller amount than would occur under unilateral reform.

Since the United States has recently signed several new FTAs and is considering others, it is important to consider how their presence affects our outcomes. As noted above, we consider a scenario in which the proposed Swiss-US agreement is implemented simultaneously with other current and prospective US FTAs that conceivably might enter into force by 2006, with the United States as the FTA hub (Chile, Australia, Singapore, Morocco agreed; CAFTA, SACU, and Thailand prospective). The results are presented in tables 8.10 through 8.14.

Table 8.9 CGE changes in returns to factors of production, Swiss-US FTA (percent change at constant prices)

	United States		Switzerland	
Factor of production	**Free trade area**	**Unilateral benchmark**	**Free trade area**	**Unilateral benchmark**
Land	0.6	0.2	–9.7	–40.9
Unskilled labor	–0.3	–0.1	0.1	1.8
Skilled labor	–0.3	0.0	0.1	2.0
Capital	–0.3	–0.1	0.8	2.4
Natural resources	0.2	0.7	–2.1	–7.6

Table 8.10 shows that the presence of the other FTA partners does not substantially alter the predicted changes in bilateral trade between the United States and Switzerland. However, there are substantial increases in total US trade, reflecting the broader array of trading opportunities that arise under the hub formation. Similarly, while the overall welfare effect is only slightly reduced for Switzerland, the benefits from multiple FTAs are much greater for the United States. Even so, they are still very small as a fraction of US GDP, reflecting both low initial US barriers to trade and the relatively small economic size of its current and prospective FTA partners.

Table 8.10 shows estimated regional welfare effects. Under the multiple FTA scenario, the effects on nonpartner countries are magnified, especially for NAFTA partners and EU members. However, the negative effects on nonmembers remain at small proportions to their GDP levels.

The regional trading pattern estimates in table 8.11 indicate that, when the Swiss-US FTA is considered in conjunction with other FTAs, the volume of bilateral trade between other US partners and Switzerland is significantly reduced. This happens because the hub-and-spoke structure does not eliminate barriers between Switzerland and the other US partners.

While estimated changes in the sectoral pattern of trade (tables 8.12 and 8.13) are not significantly different from those already discussed (tables 8.7 and 8.8), there are some differences in the volume of total US trade, especially in animal products, dairy, food, and textiles. However, tables 8.12 and 8.13 indicate that a large fraction of the projected trade changes are redirection, and production changes remain relatively small.

Summing Up

The quantitative results from the gravity and CGE models presented in this chapter offer two useful views of the economic prospects of a Swiss-US

Table 8.10 CGE changes for key variables, all US FTAs

Key variable	United States	Switzerland	Chile	Australia	Singapore	Morocco	CAFTA	SACU	Thailand
Import value (percent)	0.8	1.8	2.8	1.6	1.4	9.4	11.3	7.4	3.1
From partner(s)	38.6	31.7	36.8	17.9	1.9	143.6	53.3	48.7	53.2
From rest of world	–1.3	–2.1	–4.7	–2.1	1.3	0.1	–1.9	3.9	–2.6
Export value (percent)	1.7	1.0	1.5	0.7	2.3	–3.5	7.7	–1.6	1.1
To partner(s)	27.3	12.1	9.7	14.5	9.2	12.6	41.4	65.1	22.0
To rest of world	–0.4	–0.8	–0.4	–1.1	0.9	–5.3	–14.0	–7.9	–4.6
Tariff revenue (millions of dollars)	–2,596	–819	–241	–421	0	–153	–922	–20	–658
From partner(s)	–2,246	–324	–189	–333	0	–85	–844	–25	–444
From rest of world	–350	–494	–52	–88	0	–68	–77	6	–214
Welfare (percent of GDP)	0.0	0.0	0.2	0.0	–0.3	0.8	1.8	1.6	0.6
Total export values (millions of dollars)	1,137	53	141	132	–219	261	1,820	156	651
Allocative efficiency	6	–40	37	–24	–206	138	806	66	–154
Terms of trade	1,131	93	104	156	–13	123	1,013	90	805

Table 8.11 CGE changes in the regional pattern of exports, all US FTAs

	Initial value (billions of dollars)			**Free trade area** (percent change)		
Country/region	**Total**	**To the United States**	**To Switzerland**	**Total**	**To the United States**	**To Switzerland**
Australia	72.3	8.6	0.4	0.7	14.5	–7.3
Brazil	67.8	16.0	0.5	0.0	–0.4	–3.3
Central America	34.1	13.4	0.3	7.7	41.4	–20.0
Chile	21.7	4.0	0.1	1.5	9.7	–5.6
China	379.6	108.4	1.5	–0.2	–1.0	–3.3
Eastern Europe	340.8	24.3	5.8	0.0	–0.4	–0.8
European Union	2,477.9	287.1	62.6	0.0	–0.3	–1.8
Hong Kong	98.2	20.4	0.9	–0.1	–1.5	–4.3
Japan	448.8	123.9	2.0	0.0	0.1	–0.5
Morocco	11.2	1.1	0.1	–3.5	12.6	–9.7
New Zealand	18.1	2.8	0.1	–0.1	–0.7	–20.6
Rest of EFTA	66.4	7.8	0.4	0.0	0.0	–3.4
Rest of South America	119.7	33.5	1.3	–0.1	–0.6	–1.5
SACU	6.2	0.5	0.0	–1.6	65.1	–10.4
South Korea	175.4	37.2	0.6	–0.1	–0.5	–0.5

Switzerland	107.0	14.7	—	1.0	12.1	—
Taiwan	135.7	36.1	0.5	–0.1	–0.4	–0.4
Rest of world	507.5	99.8	3.5	–0.1	–1.1	–4.7
Indonesia	68.0	11.4	0.2	–0.1	–2.2	–1.0
Malaysia	124.4	24.0	0.3	0.0	–0.4	–2.3
Philippines	37.9	11.5	0.1	0.0	–1.1	–3.5
Singapore	110.4	17.8	0.5	2.3	9.2	–6.5
Thailand	79.4	17.2	0.5	1.1	22.0	–8.3
Vietnam	15.3	1.4	0.1	0.0	–1.1	–1.3
All ASEAN	435.3	83.4	1.7	0.8	5.9	–5.1
Canada	265.3	198.2	0.6	–0.1	–0.1	–3.3
Mexico	164.3	129.5	0.5	0.0	–0.1	–2.2
United States	881.8	—	10.8	1.7	—	31.3
All NAFTA	1,311.4	327.8	11.9	1.1	–0.1	28.3
All world	6,835.1	1,250.9	94.1	0.3	0.8	1.8

EFTA = European Free Trade Association
SACU = Southern African Customs Union

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

Table 8.12 CGE changes in the sectoral pattern of exports, all US FTAs

	United States					Switzerland				
	Initial value (millions of dollars)		Free trade area (percent change)		Total : Unilateral benchmark (percent change)	Initial value (millions of dollars)		Free trade area (percent change)		Total : Unilateral benchmark (percent change)
Sector	Total	To Switzerland	Total	To Switzerland		Total	To the United States	Total	To the United States	
Grains	9,638	8	3.0	391.5	1.5	64	0	6.3	8.4	72.9
Oil seeds	5,698	11	0.8	112.5	1.3	9	0	4.8	4.6	27.7
Plant-based fibers	2,209	4	1.0	–1.2	5.4	50	0	1.1	6.2	9.0
Other crops	8,062	57	1.0	20.3	2.1	205	7	3.8	34.0	30.8
Raw animal products	12,287	32	8.5	2,869.1	2.0	118	8	24.4	28.6	111.2
Wool	9	0	–1.5	–3.9	13.5	3	0	2.4	18.0	19.6
Forestry	1,254	3	–0.1	2.4	1.2	129	0	0.3	14.0	1.3
Coal, oil, and gas	4,246	2	1.3	9.1	2.9	57	0	0.9	2.3	4.4
Dairy products	802	2	42.1	11,723.2	2.5	361	35	40.2	339.6	31.1
Other food products	19,615	123	3.7	104.3	1.2	1,888	102	2.2	28.6	13.7
Textiles and clothing	19,337	65	20.4	60.9	8.8	2,180	172	4.8	69.4	–0.1
Wood products	8,212	17	2.2	11.3	1.7	823	27	0.0	4.6	–1.0
Paper products	20,031	88	1.5	25.7	0.9	2,001	78	–0.5	1.3	–1.5
Chemicals	117,946	1,451	1.6	3.0	1.5	24,126	2,797	0.4	11.5	–1.8
Ferrous metals	6,932	36	0.4	7.4	0.9	994	36	–0.2	9.8	–1.6
Nonferrous metals	11,379	223	0.7	0.0	2.7	5,626	465	–0.6	3.4	–1.7
Metal products	14,857	52	1.6	15.5	1.3	2,823	276	1.6	23.0	–1.9
Motor vehicles	108,533	597	1.1	3.1	1.4	2,068	336	0.0	3.4	–1.7
Electronic equipment	110,550	514	0.2	0.5	2.9	2,901	408	–1.0	–0.3	–2.7
Machinery and equipment	165,096	1,241	1.2	2.7	2.5	30,230	3,939	0.2	8.3	–2.3
Other manufactures	15,588	2,029	11.8	72.3	3.6	4,739	659	1.8	10.9	1.4
Nontraded services	4,083	16	–0.1	0.2	1.8	2,715	20	–0.9	–0.8	–1.7
Traded services	215,394	4,240	0.2	9.9	11.2	22,898	5,316	2.3	12.9	12.2

Source: Initial data from the GTAP6 database (Dimaranan and McDougall 2005). Estimates from simulation results.

Table 8.13 CGE changes in the sectoral pattern of production, all US FTAs (percent change at constant prices)

Sector	United States	Switzerland	Chile	Australia	Singapore	Morocco	CAFTA	SACU	Thailand
Grains	1.0	–0.7	0.9	–0.9	0.7	–4.3	–8.4	–8.8	–1.4
Oil seeds	0.2	–1.1	0.7	0.1	0.1	–3.0	–3.7	–5.6	–5.2
Plant-based fibers	0.3	1.3	0.8	0.2	0.3	–0.6	6.5	30.5	6.0
Other crops	–0.1	1.7	1.6	0.0	0.5	–1.2	–3.5	–5.3	0.7
Raw animal products	0.6	–6.4	0.8	1.6	1.5	0.6	–0.9	–4.7	–0.7
Wool	–0.8	2.7	1.1	–1.3	1.3	–0.2	3.8	–2.6	11.6
Forestry	0.1	–0.1	0.6	–0.2	0.9	10.4	–5.0	–4.7	–4.3
Coal, oil, and gas	0.0	0.0	0.3	–0.4	4.7	–15.2	–14.0	–8.6	–1.6
Dairy products	0.4	2.8	2.8	–0.3	3.7	–5.1	–4.5	–10.6	–2.3
Other food products	0.2	–0.1	0.8	0.5	1.7	–0.4	–2.9	–3.0	–0.3
Textiles and clothing	0.3	2.8	1.4	0.6	29.7	–0.1	40.2	42.7	19.1
Wood products	0.1	–0.4	1.5	–0.8	4.1	–1.0	–13.2	–5.4	–8.1
Paper products	0.1	–0.3	–0.5	–0.4	2.9	–4.5	–7.4	–6.9	–2.8
Chemicals	0.2	0.0	0.9	–0.6	4.4	–2.4	–7.3	–3.9	–2.5
Ferrous metals	0.1	0.0	0.7	–0.8	3.4	–1.4	–14.6	–3.7	–3.3
Nonferrous metals	0.1	–0.6	2.1	–1.7	3.9	–4.5	–21.4	8.4	–4.4
Metal products	0.1	0.7	0.8	–0.5	3.3	–0.7	–11.7	0.5	–5.2
Motor vehicles	0.1	0.4	0.7	–0.6	4.1	1.6	–6.7	–3.5	–0.9
Electronic equipment	–0.1	–0.7	–4.6	–0.7	1.9	–4.9	–23.7	0.6	–4.8
Machinery and equipment	0.2	0.0	0.4	–1.2	5.1	–1.3	–21.0	2.4	–3.2
Other manufactures	2.8	–1.7	0.7	–0.6	3.2	–2.8	–12.6	–11.4	–4.6
Nontraded services	0.0	0.4	1.6	0.3	–0.5	10.6	4.4	13.1	2.5
Traded services	–0.1	0.1	–1.3	0.0	–1.7	–0.4	–1.4	1.3	–1.6

CAFTA = Central American Free Trade Agreement
SACU = Southern African Customs Union

Table 8.14 CGE changes in returns to factors of production, all US FTAs (percent change at constant prices)

Country	Land	Unskilled labor	Skilled labor	Capital	Natural resources
United States	2.0	–0.2	–0.2	–0.2	0.1
Switzerland	–9.6	0.1	0.1	0.8	–1.9
Chile	0.5	–0.1	–0.1	0.4	–1.8
Australia	3.4	–5.5	–8.3	1.3	0.3
Singapore	–5.3	–5.4	–9.4	12.0	–20.2
Morocco	–10.7	2.1	0.5	6.9	–18.9
CAFTA	0.1	–4.1	–4.7	–2.6	3.7
SACU	–2.4	–2.8	–6.2	2.5	–3.8
Thailand	–10.0	–3.6	–6.8	13.6	–24.4

CAFTA = Central American Free Trade Agreement
SACU = Southern African Customs Union

FTA, though importantly, the estimates from the two models concur that an FTA between Switzerland and the United States would significantly expand bilateral two-way trade between the two countries. The gravity model estimates gains of about 100 percent for total trade while the GTAP projects more modest gains of between 32 percent (US exports to Switzerland) and 12 percent (Swiss exports to the United States), averaging out to an increase of about 20 percent in bilateral two-way trade. Both models suggest that much of the expansion in bilateral trade might be focused in agriculture, as the two countries currently maintain significant protection for domestic producers of dairy, grain, livestock, and other farm products, owing to the political strength of the agriculture lobbies in both countries.

The general equilibrium estimates of the GTAP model provide additional insights into the impact of a Swiss-US FTA. Although they find little improvement in overall economic welfare,[22] they point to particular sectors of both economies that would benefit from the expansion of bilateral exports. These include the dairy, grain, oilseed, and other manufacturing sectors in the United States, and dairy, raw animal products, and select manufacturing sectors in Switzerland. As for the limited overall economic gains found by the CGE model, in important respects, this outcome likely reflects deficiencies in modeling the services sector. By contrast, sector-specific studies suggest strong positive effects from liberalizing services trade (Copenhagen Economics 2005).

22. It deserves mention that the GTAP protection data for manufactured goods almost exclusively refers to tariffs, even though nontariff barriers (NTBs) are often important. If the Swiss-US FTA can make a dent in these NTBs, the calculated welfare benefits will be larger.

Spillover effects arising from trade diversion under the hypothesized Swiss-US FTA would adversely impact third countries, especially China, EU members, and NAFTA partners of the United States. These effects are generally modest in magnitude, however, and in the case of the European Union and NAFTA, they largely reflect leveling of the playing field for Swiss and US exporters owing to the dilution of preferences enjoyed by competing Canadian and Mexican exporters in the US market, and EU exporters in the Swiss market.

The essential point of the models is that a Swiss-US FTA would very likely benefit both parties. However, the spillover effects are not without their political consequences. It is thus worth examining what the consequences might be for Switzerland, as a landlocked country surrounded by members of the European Union. This is taken up in the next chapter.