THE NET WELFARE EFFECTS OF

THE 201 STEEL REMEDY

in the matter of

STEEL-CONSUMING INDUSTRIES:
COMPETITIVE CONDITIONS WITH RESPECT TO STEEL
SAFEGUARD MEASURES
Investigation No. 332-452

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I. INTRODUCTION AND SUMMARY

The Committee on Ways and Means ("Committee") has asked the U.S. International Trade Commission ("ITC" or "Commission") to evaluate, among other things, the potential economy-wide effects of the President's steel safeguard measures and discuss the likely impact "on steel consuming industries of (i) continuation of the safeguard measures for the period September 2003 - March 2005 and (ii) termination of the safeguard measures effective September 20, 2003."[1] These specific requests are necessarily forward-looking and, as noted by the Committee, require the use of appropriate economic simulation models.

In this paper, we develop and implement a methodology that compares the economic effects of continuing the safeguard measures through March 2005 versus terminating them in September of this year. Our analysis is sensitive to the underlying conditions of competition in the steel industry and incorporates key economic conditions recognized in both domestic steel producers' adjustment plans and the President's prescribed remedy. We measure the effects of continuing the remedy on (1) net national economic welfare and (2) prices, production and imports in steel-producing and steel-consuming sectors.

A. THE APPROPRIATE METHODOLOGY

Successfully evaluating the effects of the President's steel remedy on the national welfare, as well as on steel-making and steel-consuming sectors, requires the use of an economy-wide model incorporating the international linkages central to the functioning of the tariffs and other policy measures. The types of models best suited for this analysis are called "computable general equilibrium" or "CGE" models. These models, unlike more familiar partial equilibrium models, are designed to capture the interrelationships between the commodity, labor and capital markets.[2] As such, they can theoretically capture the national effects of a policy measure applied directly to a single market.

While CGE models are potentially the best tools to capture the economy-wide effects of the steel remedy, most generic CGE models fail to incorporate the key features of the remedies on the steel industry and their effects on the economy as a whole. In particular, the current remedies were imposed to increase the competitiveness of the domestic industry and allow it to adjust to import competition. A key element of this adjustment – as detailed by domestic producers in the adjustment plans that they have submitted, and as recognized by the President in the remedy that he has provided – is the increase in labor productivity consequent to industry restructuring and investment. The direct effects of policy changes on industry productivity are not normally incorporated into CGE models of trade policy initiatives. Yet, in this case, failure to incorporate

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[1] Letter from Representative William Thomas to the Chairman of the U.S. International Trade Commission, dated March 18, 2003.

[2] In contrast, partial equilibrium models are designed to estimate the effects of policy measures on a narrowly defined industry while assuming that the measures have no significant economy wide effects.

increases in industry productivity would improperly assume away a major economic benefit from the relief.

A CGE model that analyzes the effects of the steel remedy must include several other features to appropriately measure economy-wide effects. First, the model must have a long time horizon. While the remedy may only extend another 18 months, the productivity gains resulting from its continuation will last many years. Any model that fails to capture these long-lasting effects will necessarily be deficient and generate results that are unresponsive to the question posed. Second, the CGE model must be global, thereby allowing for the estimation of terms-of-trade effects. Without multi-region or multi-country capabilities, the U.S. is modeled as a "small country," an assumption that is clearly at odds with the relative importance of the United States to the world steel market. Third, the CGE model should be fully dynamic. While this feature is somewhat less important than the others discussed, it adds realism. A dynamic model allows the industry and economy to adjust to the effects of the remedy over time. A static model assumes adjustment occurs instantaneously and therefore ignores adjustment dynamics.

Despite the inherent strength of CGE models in addressing economy-wide questions, they have certain limitations that are difficult, if not impossible, to overcome in the context of the steel remedy analysis. First, CGE models track policy experiments as a movement from one equilibrium to another (hence the "E" in CGE). Thus, for example, firms (and industries) are assumed to be returning their cost of capital, an assumption clearly not valid in the case of the steel industry. Second, CGE models are calibrated to available national industry data. In general, these data are not available for a specific, narrowly defined industry. That is particularly true in this case where narrow product definitions and exemptions are prevalent. Finally, CGE models are not particularly adept at incorporating many types of non-competitive behavior. There is considerable evidence of the presence of market power in foreign steel industries.[3]

B. THE RESULTS

In conducting the analysis, we use a dynamic, multi-country CGE model that incorporates the changes in steel industry productivity arising solely from the continuation of the President's remedy from September 2003 through March 2005. The model divides each national or regional economy into fifteen sectors including the steel-producing sector and several important steel-consuming sectors including, for example, the motor vehicle and parts industry. The world is divided into the four regions distinguished by the remedy – the United States, other NAFTA countries, other countries not covered by the remedy, and countries covered by the remedy. The model simulations are extended out for ten years since the effects of increases in steel industry productivity are long-lived.

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[3] "Report to the President, Global Steel Trade, Structural Problems and Future Solutions," International Trade Administration, U.S. Department of Commerce (July 2000).

Model simulations incorporating steel industry productivity gains of 2 to 4 percent show that continuing the remedy increases net national economic welfare by $2.75 to $4.91 billion. This result is intuitive. Increased efficiency in producing steel will lower steel prices, drive down costs in steel-consuming industries, increase international competitiveness, and increase GDP. Any negative consumer effects associated with higher prices during the 18-month continuation are swamped by lower prices in the out years. Interestingly, the model also shows that the remedy increases net national welfare even absent productivity gains due to a positive terms-of-trade effect, albeit with different sectoral ramifications.[4]

The increased productivity in U.S. steel production has beneficial effects on the industry and its domestic consumers. With respect to the steel producing industry, productivity gains will increase steel output, decrease steel prices, decrease steel imports, and decrease steel employment compared to what they would have been had the remedy been terminated. Steel-consuming industries will see lower input costs, increased production, increased employment, and lower imports (due to increased international competitiveness) than if the remedy were terminated. Once again, the value of the gains to consumers swamp any offsetting costs in output associated with the 18-month continuation.

II. CGE MODELS

A CGE model is an economic model that includes many sectors of the national economy. Therefore, it is well suited for evaluating economy-wide effects of a policy change. If the policy under evaluation is a trade policy, like the Section 201 remedy, then it is appropriate for the model to also link many national economies through international trade and capital flows to form a global model.

The acronym CGE provides a description of the design and purpose of the economic model. The "E" stands for equilibrium. An equilibrium model is one that translates supply and demand conditions into market-clearing prices. In other words, economic theory, calibrated to real world data, is used to predict the reaction of prices, production, trade flows, and other economic variables to changes in supply and demand conditions. The "G" stands for general. General equilibrium means that the model is simultaneously solving for market-clearing prices and volumes in all of the markets in the economy. A global general equilibrium model is more mathematically complex than an industry-specific model, like the ITC's COMPAS model, which typically ignores the consequences of the policy changes outside of the specific industry being studied. Since a global general equilibrium model predicts the changes in economic conditions in a large number of countries, for many products and factors of production, the model's prediction for the impact of policy changes needs to be solved by computational evaluation. Equilibrium prices and quantities cannot simply be read from graphs or calculated by algebraic formulas. The "C" stands for computable.

[4] In this case, the increase in net national economic welfare is $237 million.

CGE models are benchmarked to economic data from a specific year or years. The model's baseline trajectory is calibrated to data from government statistics and other sources. This helps to ensure that the magnitudes of the measured effects are reasonable. For example, a tariff imposed by a relatively small country in a relatively insignificant industry will have little effect on that country's economy as a whole, and probably no discernable effect on world market prices. On the other hand, a tariff imposed by a very large country on a significant manufacturing industry will have sizeable effects on the national economy and on world prices.

CGE models are used by policymakers to estimate the economy-wide impacts of proposed policy actions. For example, they are used to evaluate proposed multilateral or regional trade arrangements, to estimate the effects of multinational environmental policies like carbon taxes, and to measure the broad impacts of economic trends in one country, such as growth in China, on the economies of its trade partners. In this 332 investigation, a CGE model can provide an estimate of the economy-wide impact of the Section 201 remedy.

III. INCORPORATING ESSENTIAL ELEMENTS

A. CGE MODEL MUST INCORPORATE PRODUCTIVITY TO REFLECT THE EFFECTS OF THE REMEDY

The central features of the 201-adjustment plan are the restructuring and consolidation of domestic producers through mergers and acquisitions, the shuttering of inefficient facilities, and new investments in the steel making and rolling processes. All of these features are intended to increase productivity and increase the competitiveness of the domestic steel industry. The industry has already begun implementing the adjustment plan. A number of major mergers and acquisitions have already occurred: U.S. Steel has purchased National Steel; Nucor has purchased Birmingham Steel; and ISG has purchased Bethlehem Steel, LTV Steel and Acme Metals.

Typically, CGE models of trade policy initiatives do not incorporate changes in productivity into their specification. However, productivity changes – increasing industry competitiveness – are central to both the adjustment plans of domestic steel producers and the President's reasons for affording the industry temporary relief. Changing productivity is the key to the purpose of this safeguard measure: allowing the industry to adjust to import competition.

CGE models can be modified to incorporate increases in labor productivity consequent to restructuring and capital investment by modifying the industry's production function. Every CGE model specifies how capital, labor, energy and materials are combined to produce a unit of industry output. The most straightforward method for incorporating the increase in labor productivity is to alter the production function by requiring less labor inputs for a given amount of other inputs to produce one unit of output.

The effects of increasing labor productivity in the steel industry are positive for national welfare. Steel production would increase while steel prices would fall. Some labor would move out of the steel industry and find its way to other end uses in the steel consuming industries and other sectors of the economy. Steel-consuming industries would see a fall in input prices, making their products relatively more competitive as well. National output would increase. Wages in the steel industry would rise to reflect steelworkers' increased productivity.

B. THE APPROPRIATE CGE MODEL MUST BE A MULTI-REGION MODEL THAT RECOGNIZES TERMS-OF-TRADE EFFECTS

The United States is a large country. With a GDP greater than $10 trillion, it has the largest national market for goods and services in the world. The U.S. economy is linked to the rest of the world through international trade and capital flows. Due to the size and openness of the U.S. economy, policies like the Section 201 tariffs have impacts on market prices throughout the world. As foreign prices adjust to U.S. policies, so does the pattern of trade between the U.S. and the rest of the world. Any serious attempt to model the effects of U.S. trade policy on the U.S. economy must recognize the effects of the policy on U.S. imports and exports, which includes not only the direct effects of the tariff but any consequent changes in foreign market prices that will affect the pattern of trade. The appropriate analytical tool to model these feedback effects is a global CGE model. The alternative, a so-called "small country" model, is not credible given the size of the U.S. economy and the relative size of the U.S. steel industry and steel-consuming sectors. Such a simplification ignores important effects of the tariffs like the improvement in the U.S. terms of trade.

Economists who specialize in international trade often categorize trade models as "small country" (or single-region) models or "large country" (or multi-region) models. A small country model incorporates the assumption that the country being studied is small in the sense that changes in its policies, end-user demands, or factor supplies will have no discernible effect on world prices. In short, the country's significance in the global economy is viewed as "a drop in the bucket." In more technical terms, this means that the model assumes that U.S. import prices (net of tariffs) are set on world markets without regard to what is happening in the U.S. market, and so these prices are invariant to U.S. trade policy.

One reason for adopting a small country assumption is its simplicity. By assuming that import prices (net of tariffs) are invariant to U.S. trade policy, the model does not specify how prices are set in foreign markets – it does not need to because the model does not predict how they would be reset in response to a change in U.S. policy.

The obvious problem with building a model based on a "small country" assumption is that it is entirely unrealistic as a description of the U.S. economy and other large economy countries. Perhaps it is a justifiable simplification for a country like Costa Rica, whose GDP is only a small fraction of the size of the U.S. economy.

In contrast, a large country model does not rely on this simplifying assumption. Instead, it explicitly solves for the global market equilibrium at each time period for each product based on supply and demand conditions in all the countries that are linked by international trade and capital flows. The main benefit of using a large country model is that it is a much better fit for the reality of the global economy. The drawback of a large country model is its challenging data requirements. However, an economic analyst need not start from scratch in order to build a large country general equilibrium model. In fact, international databases like GTAP have been developed and are publicly available.[5]

In a large country model, if one country imposes a tariff it can improve its terms of trade and therefore its national welfare, though at the expense of countries whose imports are covered by the tariff. A country's terms-of-trade are defined as the ratio of the price of its exports to the price of its imports (net of tariffs). As this ratio rises, a country's terms-of-trade improve, and its consumers are able to purchase a greater volume of the imported goods in exchange for a given volume of exports. This improvement in the purchasing power of the country's consumers typically leads to a net welfare improvement for the country.

The terms of trade benefit of the Section 201 remedy can be explained as follows. The tariffs shift demand for certain steel products in the U.S. market, from covered steel imports and toward domestically produced steel and steel imported from countries that are not covered by the President's Section 201 remedy. Since the U.S. steel market accounts for a significant share of global demand, this shift in demand within the U.S. affects prices in foreign markets.

The shift in demand toward domestic producers stems the disorderly downsizing of the U.S. industry and allows adjustment to proceed according to plan. Capital and labor in the domestic industry do not flood from the steel industry to the unemployment line or to U.S. export industries (which would increase the supply of U.S. exports and drive down their prices).

The shift in demand in the U.S. market also reduces steel production in covered countries. These countries reallocate their capital and labor to other products, some of which are exported to the U.S. The greater supply of these other exports reduces their price, all else equal, and therefore reduces their cost to U.S. consumers. Since the tariff helps to maintain U.S. export prices while driving down U.S. import prices (net of tariff revenues that go to the U.S. Treasury), the U.S. experiences a terms-of-trade improvement.

There is a classic literature in the field of international economics that discusses how a tariff can improve a country's terms-of-trade. Trade economists have written about this for decades. It is discussed at length in the vast majority of undergraduate and

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[5] Betina V. Dimaranan and Robert A. McDougall, eds. Global Trade, Assistance, and Production: the GTAP 5 Data Base. Center for Global Trade Analysis, Purdue University, May 2002.

graduate textbooks on international trade under the title "optimal tariffs." In a well-regarded undergraduate textbook on international trade, Caves, Frankel, and Jones (1993) explain the impact of a tariff on world and domestic prices.[6]

> If the tariff-levying country is not small in relation to competitive world markets, its tariff will drive down the relative world price of imports or, equivalently, raise the relative world price of its exports. The tariff can improve a country's terms of trade.[7]
>
> ...
>
> Furthermore, the terms-of-trade improvement that would occur when a small tariff is first levied must improve welfare. Obviously, there must be some intermediate tariff rate, t_0, that is "optimal" in that it maximizes the level of domestic welfare.[8]

In their undergraduate textbook on international economics, Krugman and Obstfeld (1997) provide a fairly simple proof that the optimal tariff is greater than zero.[9]

The terms-of-trade effect of a tariff is a conventional feature of large country models but is not apparent in small country models, since the latter ignore the effect of U.S. trade policy on prices in the rest of the world. Ignoring the terms-of-trade effect of the Section 201 remedy would be a significant cost of adopting the simplifying assumptions of a small country model.

This analysis of terms-of-trade effects leads to the following hypothetical but nevertheless powerful conclusion. Even if the President's remedy did not result in productivity gains for the U.S. steel industry, the tariffs would result in a terms-of-trade improvement over the next eighteen months that would have a positive net welfare effect on the U.S. economy. But, in fact, these term-of-trade gains are swamped by the benefits of the productivity gains resulting from continuation of the President's remedy.

C. THE MODEL MUST HAVE A LONG TIME HORIZON TO CAPTURE THE EFFECTS OF THE REMEDY

The consequences to national welfare of keeping the remedy in place for an additional 18 months extend well beyond the remedy period. This is because the positive changes in labor productivity engendered by continued industry restructuring and investment (contingent on the additional 18 months of protection) will last well into the

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[6] Richard E. Caves, Jeffrey A. Frankel, and Ronald W. Jones. World Trade and Payments: An Introduction. Sixth Edition. New York: Harper Collins, 1993.

[7] Caves, Frankel, and Jones (1993), p.205.

[8] Ibid., p.207.

[9] Paul R. Krugman and Maurice Obstfeld. International Economics: Theory and Policy. Fourth Edition. Reading, MA: Addison-Wesley, 1997.

future. Thus, any CGE model that estimates national welfare effects only over the 18-month period is deficient.

It is not difficult to implement a CGE model incorporating both temporary and permanent changes to its structure. The modeler simply keeps the tariff and tariff rate quota in place for 18 months then removes them in later periods. Productivity changes, on the other hand, are best represented by a gradually increasing schedule of improvements in labor productivity that extends into the future. The effect of the continuation of the remedy on national welfare is the present discounted value of all future welfare changes.

D. THE EFFECTS OF THE REMEDY ARE BEST CAPTURED USING A DYNAMIC CGE MODEL

CGE models are often distinguished by whether they are "static" or "dynamic." In this section, we explain the distinction and why a dynamic model provides a more realistic description of the economy and therefore generates more reliable estimates of the continuing benefits from the President's remedy over the appropriate time horizon.

A dynamic model recognizes that the economy adjusts gradually over time to changes in policies like tariffs. The model structure incorporates forward-looking investment and savings behavior, so that businesses, individuals, and governments anticipate the effects of announced policies that are to take effect (or in this case expire) in the future. Entrepreneurs choose investment levels to maximize the net present value of profits, and savings behavior is determined by intertemporal utility maximization. Therefore, investment dollars are placed in the area where they will receive the highest return.

In contrast, a static model ignores the gradual adjustment process. Basically, it predicts what the new market equilibrium will be after all adjustment has been completed. Applying a static model to estimate the economic effects over the next eighteen months is tantamount to assuming that adjustment is nearly instantaneous, which is clearly not the case.

Again, the tradeoff here is between simplicity and realism. It is more complicated to solve dynamic models. Dynamic modeling involves simultaneously solving for equilibrium prices and quantities in each period, taking into account intertemporal budget constraints and savings and investment behavior. However, building dynamic models is not formidable, and they offer far more realistic estimates of the future effects of current policies, which is crucial in this case because the benefits of the remedy to the U.S. economy persist over time.

IV. CGE MODEL ESTIMATES OF THE ECONOMY-WIDE EFFECTS OF CONTINUING THE PRESIDENT'S REMEDY

A. THE CRA-CGE MODEL[10]

The CRA-CGE model is used to calculate the effects of the continuation of the remedy. It is a multi-regional, dynamic model that allows for the incorporation of productivity effects and has the flexibility to evaluate the economic effects over the most appropriate time horizon. Thus, it is one of a class of models that incorporates all of the essential features necessary to analyze the effects of the remedy on U.S. welfare.[11]

The CRA-CGE model aggregates countries into four geopolitical regions: the United States, NAFTA countries other than the United States, other countries not covered by the Section 201 tariffs, and countries covered by the Section 201 tariffs. Within each region, the industries are aggregated into fourteen sectors: Iron and Steel, Fabricated Metal Products, Motor Vehicles and Parts, Other Transportation Products, Electronic Equipment, Machinery and Equipment, Other Manufactures NEC, Construction, Energy, Services, Mining, Food, Chemical Rubber and Plastic Products, and an aggregate of all other goods.

It should be noted that the Iron and Steel sector includes products that are not covered by the remedy. No international database is available that can identify the volume and value of all the covered products within each country, much less their upstream and downstream links with others sectors of the economy and the requisite trade flows. Thus, data constraints limit the ability of the model to estimate the positive effects of the Section 201 remedy on those sectors of the U.S. steel industry that, in fact, benefit from the remedy. For this reason, we represent the remedy as a weighted average tariff on the whole sector. This is conventional and yields excellent results for the intended purpose of this analysis as defined by the Committee: measuring the magnitudes of the economy-wide effects and the effects on steel-consuming industries. However, it should be noted that the steel-producing sector of the model includes products not subject to the remedy. Consequently, the magnitude of the simulated effects (in percentage changes) reported in this sector will be smaller than if it included only the products subject to the remedy.

Finally, it should be noted that while the CRA-CGE model can reliably estimate consumer effects over several years, it understates short-run price dynamics. The CRA-CGE model, like most other CGE models, assumes that factors of production can be reallocated quickly and flexibly between domestic industries, though this is often not the case. For example, the models assume that there are no constraints on capital investment, meaning that new capital can be installed immediately, without any time-to-build

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[10] The Technical Appendix contains a more thorough discussion of the model.

[11] For an example of a related model, see Bernstein, Paul, W. David Montgomery, and Thomas F. Rutherford (1999): "Global impacts of the Kyoto agreement: results from the MS-MRT model", *Resource and Energy Economics* 21: 375-413

limitations, and that domestic producers have unfettered access to capital markets and therefore face no financial constraints. CGE models also typically assume that there is perfect labor mobility between industries.

The consequence of these assumptions about short-run adjustment is that the models predict relatively large changes in quantities in various industries with almost no effect on prices. Under these assumptions, a tariff on imported steel results in a domestic supply response that offsets almost all of the upward pressure on prices. In other words, domestic supply is very elastic in the short-run.

To illustrate the point, consider the price effects predicted by the economic models submitted to the Commission by CRA and CITAC in the remedy phase of the Section 201 investigation in November 2001. The simulation model that CRA submitted recognized that supply in the domestic steel industry would be relatively inelastic in the short-run and consequently the magnitudes of the estimated price effects were a fairly accurate predictor of actual short-run price movements over the past year. In contrast, the CGE study submitted by CITAC predicted incorrectly that the price effects of the remedy would be minimal. Other models that incorporated very elastic supply performed equally poorly.

While the assumption of short-run supply elasticity that is embedded in CGE models is not a realistic assumption for modeling short-run price dynamics in the U.S. steel industry, it does provide more reliable estimates of consumer effects over a longer time horizon. The reason that the model's predictions about prices are more accurate over the longer time horizon is that its assumptions that factors of production are variable rather than fixed, and that capital investment in particular industries is unconstrained, are clearly more realistic. In other words, it provides a fairly reliable estimate of price and welfare effects over the longer run. That is exactly the way that it is used in this report – to estimate the present discounted value of net welfare effects over the next ten years.

B. THE POLICY EXPERIMENT

The CRA-CGE model generates a forecast of the impact of continuation of the remedy on economic outcomes like market prices and the volumes of production and trade. Policy analysis requires a clear definition of (1) the policy experiment, (2) the appropriate way to measure the change in economic welfare, and (3) the appropriate time horizon over which to measure these economic impacts.

The "policy experiment" is a technical term for the description of the policy changes and associated changes in economic conditions that are inputs into the CRA-CGE model. In this case, the policy experiment is the continuation of tariffs on certain imported steel products for the next eighteen months and associated changes in labor productivity in the domestic steel industry.

We calculated the magnitude of incremental tariffs by calculating an average tariff rate on steel imports (HTS 72) before and after March 2002. The average duty rate,

calculated as the ratio of calculated duties on imports from covered countries to the total customs value of these imports, was 1.43% in the twelve months ending February 2002 and 6.04% in the twelve months ending February 2003. We consider the 1.43% average rate prior to the remedy to be an appropriate baseline, so we calculated the incremental tariff rate – the increase in tariffs resulting from the Section 201 remedy – as the difference between the 6.04% average rate and this baseline rate. Therefore, the incremental tariff in the first year of the President's remedy was 4.60%. We estimate the incremental tariff rate for the second and third years of the remedy using the digressivity scheme in the President's remedy plan: the rate in the second year is 80% of the rate in the first year of the remedy; the rate in the third year is 60% of the rate in the first year. Therefore, the incremental tariff rate used in the model run was 3.68% for the first six months after the midpoint of the remedy (October 2003-March 2004), 2.76% for the next twelve months (April 2004-March 2005), and 0% in all months after the three years of the President's remedy.

The domestic steel industry is expected to achieve significant productivity improvements if the President's remedy is continued for eighteen months and the effort to consolidate and restructure the industry is allowed to run its course. While it is difficult to precisely estimate the increases in labor productivity and other efficiencies that will result from industry consolidation and restructuring, there are many indications that they will be substantial. The merging of U.S. Steel and National Steel and the restructuring of LTV provide good examples.

U.S. Steel agreed to purchase substantially all of the steelmaking and steel finishing assets of National Steel. This is a prime example of the industry consolidation that has been made possible by the remedy, and also of the productivity gains that will result. Regarding this transaction, U.S. Steel predicts substantial increases in labor productivity as well as other cost savings.

> "The new labor agreement provides for a workforce restructuring through which U.S. Steel expects to achieve productivity improvements of at least 20 percent at both U.S. Steel and National facilities...the company expects annual acquisition synergies of at least $200 million within two years of completing the transaction...these savings are expected to result from a number of actions including increased scheduling and operating efficiencies, the elimination of redundant overhead costs, the reduction of freight costs and the effects of the new labor contract as it relates to active employees at the acquired National facilities. Savings related to the application of the new labor contract to existing U.S. Steel facilities are in addition to this synergy amount."[12]

[12] U.S. Steel Corporation Press Release (April 21, 2003): "U.S. Steel Receives Bankruptcy Court Approval for Purchase of National Steel Assets."

In January 2003, an analyst report on steel consolidation by Bradford Research Inc. estimates that new labor contracts and industry consolidation will dramatically increase the competitiveness of the domestic steel industry.

> "The closure of LTV's plants was a major wakeup call for the USWA and when ISG took over the plants and was able to operative with less than 3,000 employees compared to LTV with more than 10,000, the obvious need to eliminate work rules became essential. It is better to save 3,000 good jobs than to lose all 10,0000."[13]

In the CRA-CGE model, we model the economic impact of the remedy for two productivity improvement scenarios.

- In the first scenario, we assume that labor productivity does not increase from baseline levels for the first six months, then increases by 0.5% relative to the baseline for the following year, then increases by 1% relative to the baseline for the following year, and then increases by 2% relative to the baseline thereafter.

- In the second scenario, we assume that labor productivity does not increase from baseline levels for the first six months, then increase by 0.5% relative to the baseline for the following year, then increases by 2% relative to the baseline for the following year, and then increases by 4% relative to the baseline thereafter.

In both cases, the increases in productivity are contingent on the continuation of the remedy and are not based upon lingering effects from the tariffs in the first eighteen months of the remedy. The baseline scenarios are based upon termination of the remedy and, consequently, on no additional productivity increases. The assumed productivity increases are quite conservative given the predictions of the industry for future consolidation, restructuring and investment should the remedy be continued. These expectations are based, in part, upon the magnitude of the actual or anticipated gains made during the first 18 months of tariffs.

We measure the impact on national welfare as the sum of economic benefits net of losses to US consumers, producers, and government revenues that are generated by the tariffs and the associated productivity increases.[14] The ten-year model recognizes that the benefits and costs persist for several years. Future benefits and costs are captured by calculating the total "present value" of these benefits and costs.

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[13] Bradford Research Inc. (January 27, 2003): "Steel Consolidation."

[14] Technically, we measure the dollar impact on national welfare by calculating the "equivalent variation" between the baseline and forecasted prices and volumes. The equivalent variation is a conventional measure of the change in national welfare equal to the change in income that would result in an equivalent level of consumers' welfare given the remedy-induced change in consumption but valued at baseline prices. For more details on equivalent variations, see Varian, Hal R. (1992). *Microeconomic Analysis*, Third Edition. New York: W.W. Norton & Company. Page 21.

C. THE ESTIMATED EFFECTS OF CONTINUING THE REMEDY

The model estimates the impact on prices, production, trade, and economic welfare for each six-month time period over the next ten years. We report a set of results that is representative of the impact of the President's remedy on the economy as a whole and also the price, production and trade effects in the domestic industries that are most directly affected by the President's remedy.

As a measure of the impact on the economy as a whole, we calculated the present discounted value of changes in national welfare over the model's time horizon. The present discounted value is the sum of future changes in our dollar measure of national welfare, with future changes discounted to their current dollar value. The extent of discounting of future benefits and costs depends on the discount rate and also on how far into the future the benefits and costs will be realized. We use an annual inflation rate-adjusted (i.e., real) discount rate of 5%. The welfare effects are reported in current (2003) dollars.

TABLE 1

	4% Productivity Gain	2% Productivity Gain
Increase in US Welfare	$4.91 billion	$2.75 billion

The net welfare gains in the U.S. economy will be substantial. The CRA-CGE model conservatively estimates that the present discounted value of these gains over the next ten years will be $4.91 billion (with a 4% long-term productivity improvement) or $2.75 billion (with a 2% long-term productivity improvement), depending on the magnitude of productivity improvements that result from industry consolidation and restructuring during the remedy period. The dynamic general equilibrium model estimates the effects of continuation on prices, production, and imports for each six-month period over the next ten-year. These effects are illustrated in Figures 1 through 11. Generally, the future effects are quite different from the temporary effects over the next eighteen months. The future effects resulting from increased productivity account for a large portion of the net welfare gains because they are persistent.

Figure 1 shows the effects over time on the prices of U.S. steel producers. Prices will be higher relative to the baseline during the next eighteen months if the President's remedy is continued. On the other hand, they will be lower relative to the baseline in the following years due to the increased productivity of the domestic industry. These lower

prices in the future will benefits U.S. steel-consuming industries as well as their consumers. The lower future steel prices represent gains not losses for the domestic steel industry, since they are caused by productivity-based reductions in cost.

FIGURE 1: US Steel Industry Prices

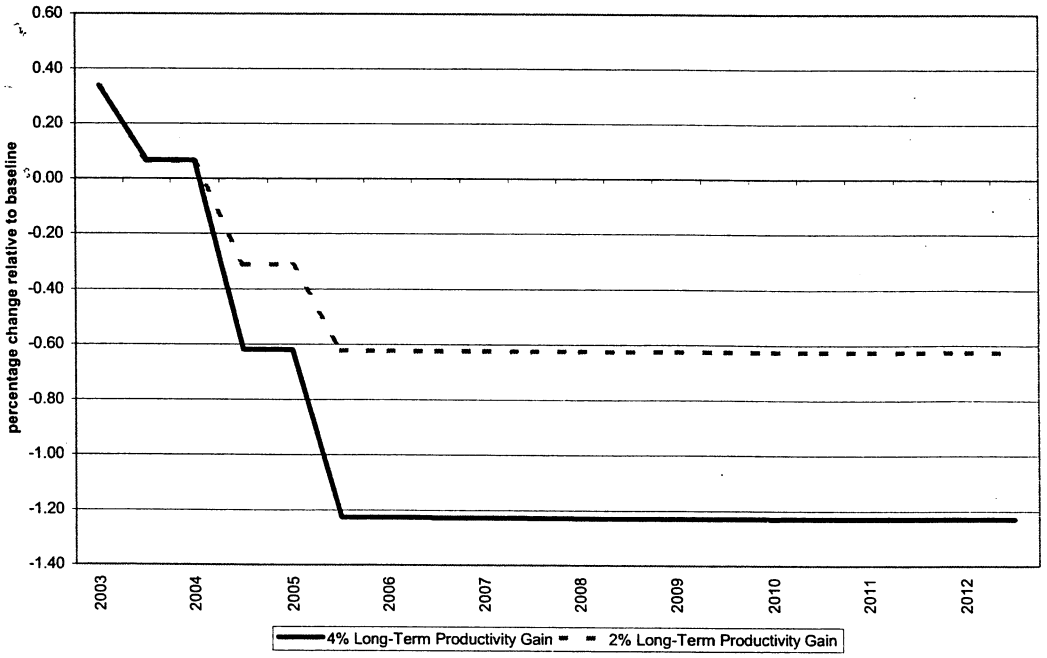


Figure 2 shows the impact over time on U.S. steel output. While the remedy is in place, production will be high relative to the baseline while the President's remedy is in place due to the increased demand for domestic steel. It will rise even higher relative to the baseline in the following years as the productivity increases are realized. Figure 3 shows that U.S. steel imports are lower over the next eighteen months, a direct effect of the trade restrictions. However, they remain below the baseline level even after the tariffs end, because there is a permanent increase in the competitiveness of the domestic steel industry.

Production in key U.S. steel-consuming industries will benefit from the continuation of the remedy. Figures 4 through 7 show the effects over time on domestic production of motor vehicles, fabricated metal products, construction, and machinery. While the tariffs are in place and steel prices are above baseline levels, production in these steel-using industries declines relative to the baseline. However, in the following years, when the domestic industry starts to realize the productivity improvements resulting from the remedy, the steel-consuming industries benefit from lower steel prices. Since employment in these downstream industries typically increases with higher production, these positive production effects in the future mean long-term employment gains for these steel-consuming industries (relative to the baseline) that are a direct consequence of the continuation of the President's remedy.

V. CONCLUSIONS

Continuation of the President's steel remedy results in gains in the net welfare of the United States. The welfare gains are significant – between $2.75 and $4.91 billion – when productivity gains engendered by the remedy are incorporated into the calculation. Net welfare is also enhanced by continuation of the remedy even if productivity gains are ignored. This is because the steel tariffs generate positive terms of trade effects.

Steel-consuming industries are made better off by the continuation of the remedy because higher steel costs over the remainder of the remedy period are more than offset by declines in steel costs extending well into the future. As a result, domestic production and employment in the steel consuming sectors increase with the continuation of the remedy.

FIGURE 2: US Steel Industry Production

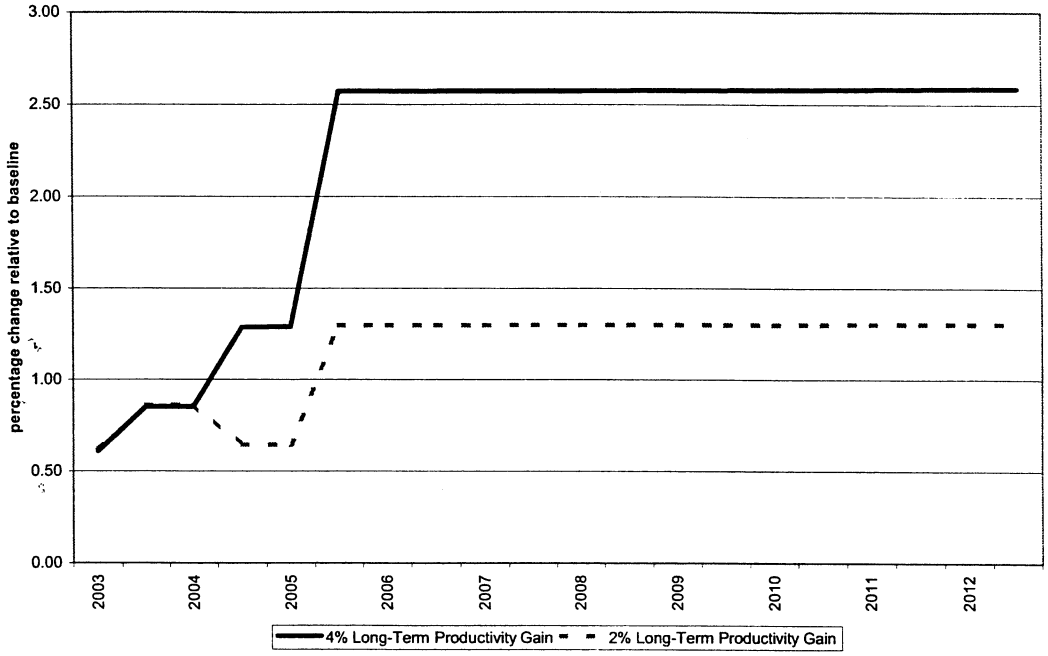


FIGURE 3: Volume of US Steel Imports

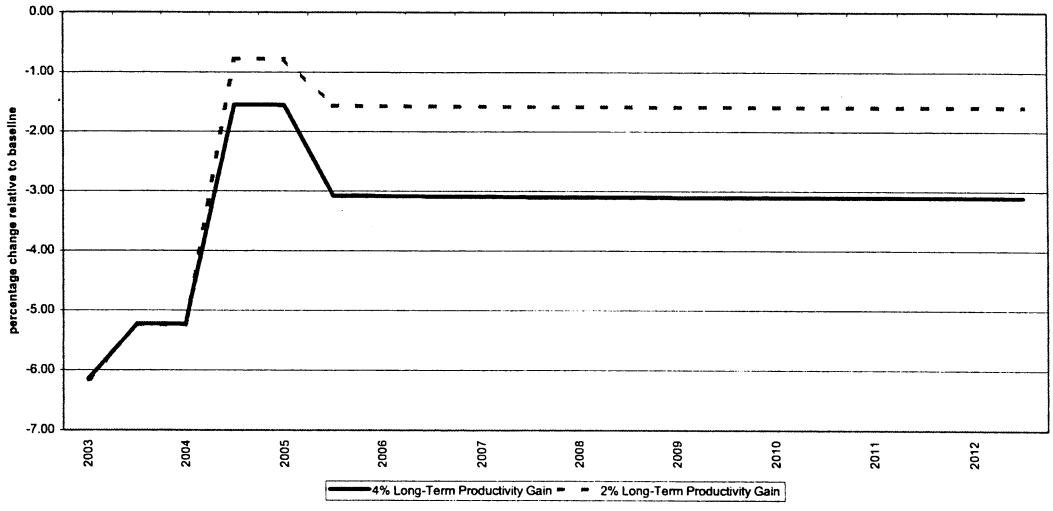


FIGURE 4: US Production of Motor Vehicles and Parts

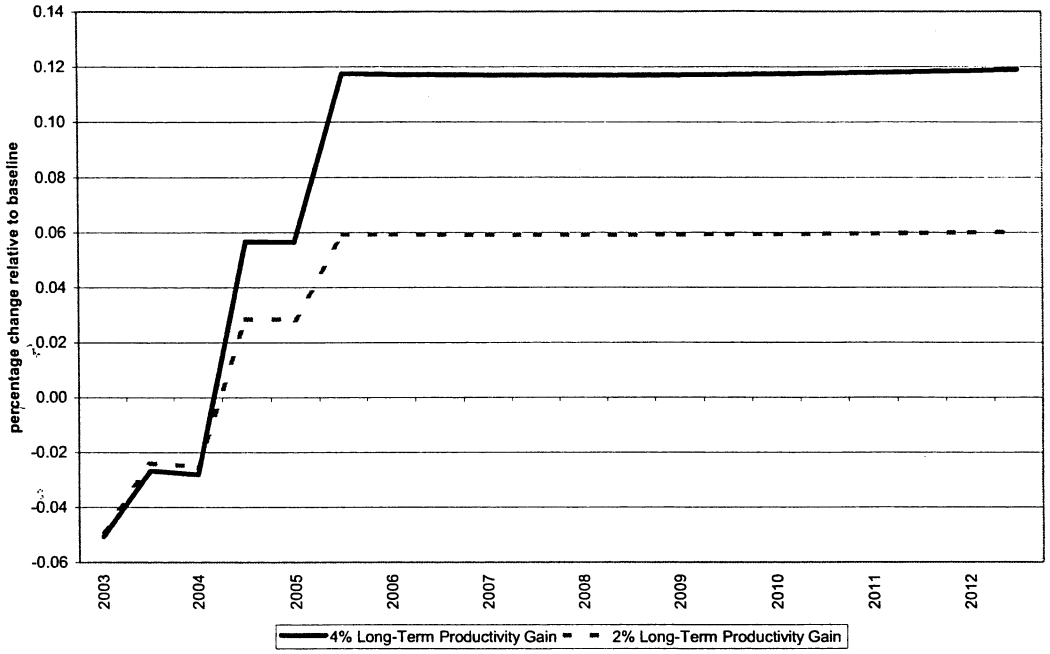


FIGURE 5: US Production of Fabricated Metal Products

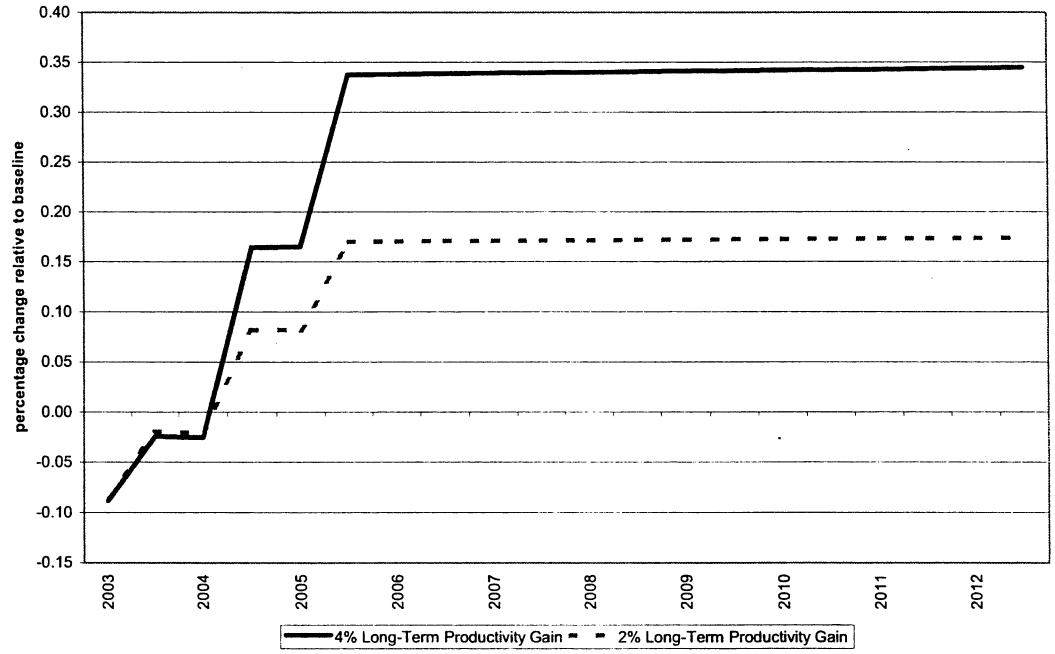


FIGURE 6: US Construction Sector Production

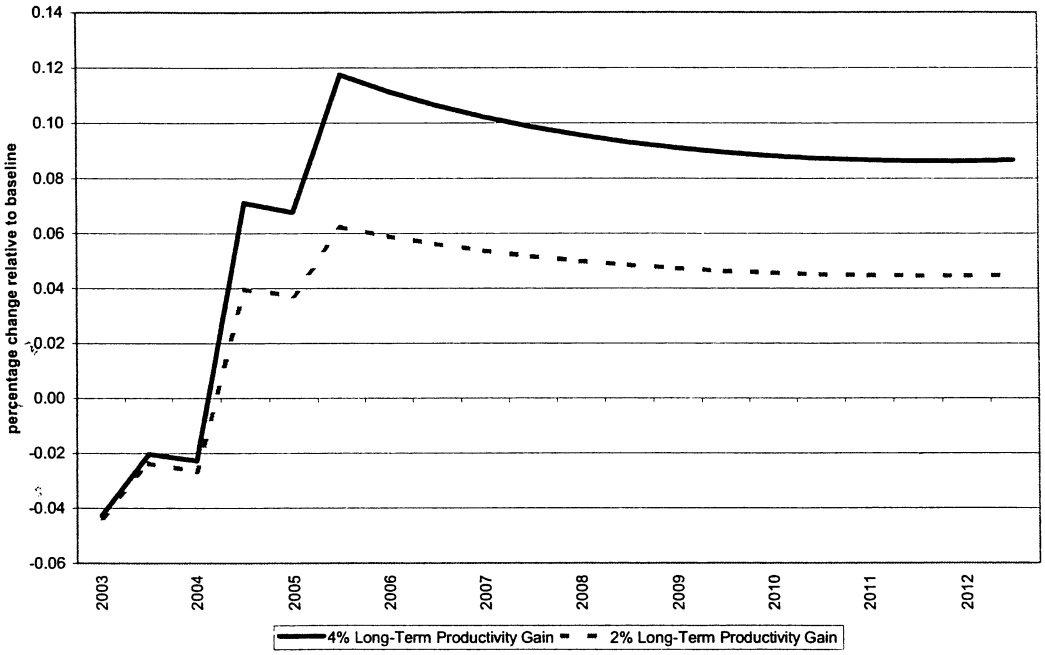
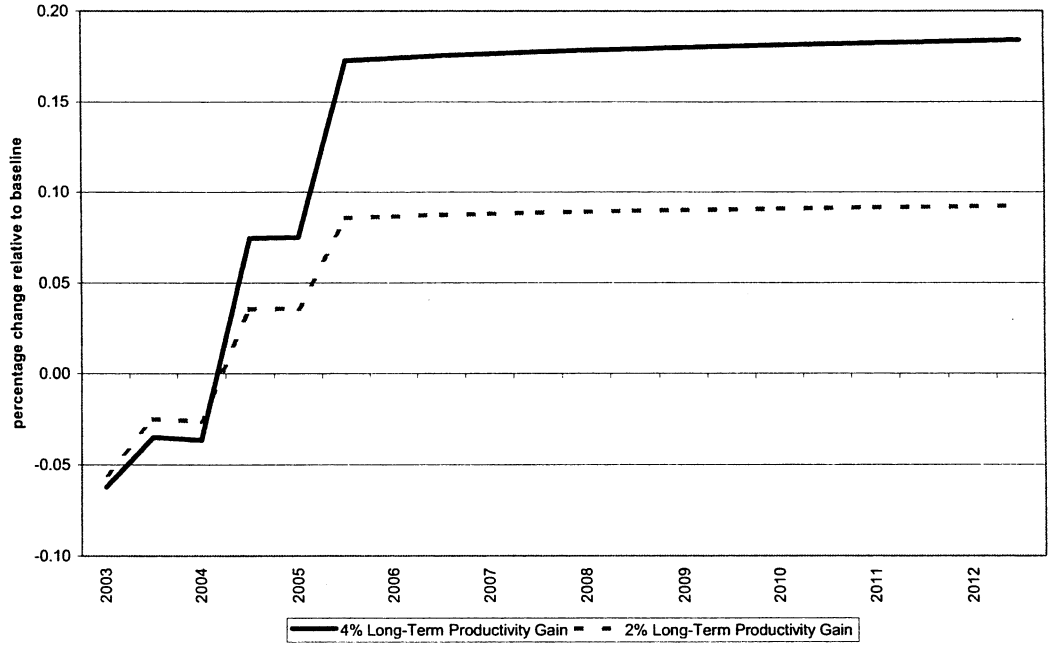


FIGURE 7: US Machinery Production



VI. TECHNICAL APPENDIX

A. OVERVIEW OF THE MODEL

The CRA-CGE remedy model is a modification of CRA's Multi-Sector Multi-Region Trade (MS-MRT) Model. It is designed to estimate the economic costs and benefits of continuing the President's remedy for the remaining eighteen months. It has the following important characteristics:

- It incorporates the productivity improvements that are an integral part of the remedy.

- It is a fully dynamic model that estimates the economic effects of the remedy that will persist into the future. Saving and investment decisions are based on full intertemporal optimization. The model solves in half-year intervals from October 2003 (the midpoint of the President's three-year remedy) to October 2012.

- It is a global (multi-region) general equilibrium model that addresses the terms of trade effects of the remedy. The multi-region general equilibrium model includes a disaggregated representation of industries, based on the GTAP5 dataset, so international differences in industry composition are taken into account.

For these reasons, this applied CGE model provides a conservative and reliable estimate of the net welfare gains that will result from continuation of the remedy. The model computes changes in national welfare, the terms of trade, and output, imports, and prices that result from the combination of trade restrictions and industry consolidation that define the President's remedy. Therefore, these estimates are directly relevant to the Commission's 332 investigation.

Conceptually, the model computes a global equilibrium in which supply and demand are equated simultaneously in all markets. The model is built on the following elements, which are conventional in applied CGE models. Wages adjust to clear the labor market. The intertemporal budget constraint ensures that new additional borrowing is eventually repaid. Changes in the prices of internationally traded goods translate into changes in the terms of trade between regions. Economic decision makers correctly anticipate future changes in economic conditions and incorporate them into their saving and investment decisions. The model uses an Armington structure in its representation of international trade in goods. That is, for all goods, domestically produced goods and imports from every other region are differentiated products. Domestic goods and imports are combined into Armington aggregates, which then function as inputs into production or consumption.

The CRA-CGE model aggregates countries into four geopolitical regions: the United States, NAFTA countries other than the United States, other countries not covered by the Section 201 tariffs, and countries covered by the Section 201 tariffs. Within each

region, the industries are aggregated into fifteen sectors: Iron and Steel, Fabricated Metal Products, Motor Vehicles and Parts, Other Transportation Products, Electronic Equipment, Machinery, Other Manufactures NEC, Construction, Energy, Services, Mining, Food, Chemical Rubber and Plastic Products, a Savings Good, and an aggregate of all other goods.

The model is benchmarked to baseline rates of economic growth and a common rate of return on capital in all countries. The rate of growth in the effective labor force (population growth plus factor-augmenting technical progress) and the consumption discount rate are computed to be consistent both with the rates of growth and return on capital, and with zero capital flows between regions on the balanced growth path.

B. Discussion of the Structure of the Model

This section offers a non-technical discussion of the important elements of the CRA-CGE model: production, international trade, and investment.[15]

Production Structure

All industries have a similar production structure. Materials (outputs of the industries used as inputs in other industries) enter the production function with a value-added aggregate and an energy aggregate. The value-added aggregate is a combination of capital and labor. When the value share energy in an industry is small, the elasticity of substitution between the value-added aggregate and the composite energy good is equal to the own-price elasticity of demand for energy.

The elasticity of substitution between labor and capital is one.[16] These two factors of production may be substituted directly for each other through activities such as the automation of labor-intensive tasks. The higher the wage rate, the more attractive it becomes to adopt automation. Labor inputs in this model are measured in efficiency units.

Labor supply is inelastic. Growth rates in the labor force are exogenously specified, so that the effective labor endowment for each region increases over time with labor force efficiency and population growth along the region's baseline growth trajectory. Labor force efficiency within the US steel industry is specifically adjusted according to the productivity increases resulting from the President's remedy.

Capital stocks evolve through geometric depreciation of existing capital stocks and new investment of sector-specific capital (within countries). The rates of return on

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[15] For a mathematical description of the related MS-MRT model, see Bernstein, Paul, W. David Montgomery, and Thomas F. Rutherford (1999): "Global impacts of the Kyoto agreement: results from the MS-MRT model", *Resource and Energy Economics* 21: 375-413.

[16] The results reported in the text are generally not sensitive to this assumption.

capital clear the international capital market. The model is calibrated to an equalized net rate of return equal to 5 percent.

Household Behavior, Consumer Choice, and the Representative Agent

For each region, consumers are modeled using a conventional "representative agent" simplification. The consumer chooses to allocate income over the time horizon in order to maximize welfare. In each period, the consumer decides how much to spend on current consumption and how much to save for future consumption. The pure rate of time preference between current and future consumption determines the intertemporal allocation of consumption. In equilibrium, the agent is indifferent between consuming one unit of consumption today or consuming the value of one unit of consumption that is adjusted for time preference tomorrow. We employ an intertemporal separable utility function where the intra-period utility from consumption is based on a nested CES function over imported and domestic commodities. The representative agent maximizes utility subject to an intertemporal budget constraint.

The budget constraint equates the present value of consumption demand to the present value of all income less the value of post-terminal capital. In this formulation, savings decisions ensure that marginal utility of an additional unit of investment equals the marginal utility of an additional unit of current consumption. Current consumption is a CES aggregate of the sectors with an elasticity of substitution of one.[17] Income is derived from the value of the household's endowments of labor, capital, and energy-specific resources. Each good in the nest is an Armington composite, in which domestic and imported goods are combined in the manner described below.

International Trade

On the import side, consumers and industries choose between domestically produced goods and imports. An Armington trade structure is used, so the model differentiates between domestic and foreign goods. Small price differences across regions for a good do not lead to a total shift in demand from one region to another, and moderate changes in costs lead to small movements away from existing trade patterns. Imports of each good from each region substitute for each other with an elasticity of substitution of 4. The aggregate import good substitutes for the comparable domestic good with an elasticity of substitution of 4.[18] These elasticities of substitution are within the ranges typically estimated by the ITC staff in Title VII investigations.

[17] The results reported in the text are generally not sensitive to this assumption.

[18] The results reported in the text are generally not sensitive to this assumption.

The model incorporates international markets for all goods. For these goods, the following global market-clearing conditions hold:

$$\sum_r X_{rt}^j = \sum_r M_{rt}^j \quad \text{for all time periods } t\text{, for all products } j\text{, for all regions } r$$

The model is closed with respect to international trade through the conventional intertemporal budget constraint. The intertemporal budget constraint for each region requires that the net present value of international borrowing or lending remain equal to the baseline level over the model's time horizon. This implies that any change in capital flows sum to zero (in present value terms) over the time horizon. Since the current account surplus or deficit equals net international lending or borrowing, this also implies that the present value of the sum of changes in the current account are equal to zero over the time horizon.

Savings and Investment

The CRA-CGE model is a fully dynamic general equilibrium trade model. The model structure incorporates forward-looking investment and savings behavior, so businesses, individuals, and governments anticipate the effects of announced policies that change over time. Entrepreneurs choose investment levels to maximize the net present value of profits, and savings behavior is determined by intertemporal utility maximization. Therefore, investment dollars are placed in the area where they will receive the highest return.

Physical capital stocks depreciate at a constant geometric rate, and they are incremented by investment from domestic output. The finite horizon requires a specific assumption about the determination of the terminal capital stock. In the absence of any terminal adjustment, agents would consume all capital stock in the terminal period and thus let the value of the capital stock decline to zero after 2012. This would have significant repercussions for rates of investment in the periods leading up to the end of the model horizon. To correct for these effects, we apply an auxiliary equation dealing with the terminal capital stock.

It should be emphasized that we apply this side constraint along with the other economic equilibrium conditions (zero profit, market clearance, and income balance), but the application of this constraint has no implications for investment and consumption activities because these impacts do not enter into the zero-profit conditions for these activities. Instead, we close the model by including a terminal capital stock variable, the quantity of which is determined so that the rate of growth of terminal investment is balanced. That is, the shadow price of the above auxiliary constraint is the price of the terminal capital stock.

C. BENCHMARKING AND CALIBRATION

This section describes how the model was benchmarked and calibrated. Following the conventional practice in applied general equilibrium analysis, the model is benchmarked to economic transactions in a particular year. Benchmark data determine the parameters and coefficients (value shares) of the CES production, demand, and utility functions. Base-year statistics indicate the value of payments to capital across sectors and the gross value of capital formation. The GTAP base year data from 1997 were adjusted to reflect observed economic growth between 1997 and 2003, and these data are then projected forward using the Energy Information Agency's projections for GDP growth rates to form the baseline trajectory of the dynamic model.