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THE GLOBAL ECONOMIC IMPLICATIONS OF GERMAN UNIFICATION

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## ABSTRACT

This paper uses a multi-country econometric model to assess the global impact of rapid economic integration of the two Germanys. The fundamental assumptions are that East Germany brings relatively more labor than capital to the union than does West Germany, and that the economic structure of a united Germany is essentially identical to that of pre-unification West Germany. In all of the simulations economic union leads to an acceleration of growth and investment in Germany, a real appreciation of the Deutsche-mark, and a reduction in Germany's current account surplus. The impact of German economic unification on other countries is relatively modest, as the additional investment demand is not large relative to global investment and a disproportionate share of that investment demand is met by domestic German savings.

## The Global Economic Implications of German Unification

Lewis S. Alexander and Joseph E. Gagnon<sup>1</sup>

### INTRODUCTION

The political transformation of East Germany passed a significant watershed on March 18 when competitive parliamentary elections were held for the first time since 1933. This election, and the events that preceded it, have raised the possibility that the economies of the two Germanys will be integrated rapidly.

This paper uses a multi-country econometric model to assess the global impact of rapid economic integration of the two Germanys. The model in question, the Federal Reserve Board staff's MX3 model, is forward looking and its long-run properties are similar to that of a neoclassical growth model. German economic unification is modeled by increasing the productive capacity of the West German sector of MX3 to reflect the inclusion of East German factors of production in an expanded German economy. A critical assumption is that East Germany brings relatively more labor than capital to the union. As a result, economic integration increases the marginal product of capital in a unified Germany, and hence the return to investment, above that in West Germany prior to unification.

In all of the simulations economic union leads to an acceleration of investment and growth in a united Germany, a real appreciation of the Deutschemark, and a reduction in Germany's current account surplus. Alternative assumptions about German monetary policy affect the real rate of

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1. Economists, Division of International Finance, Board of Governors of the Federal Reserve System. We would like to thank Bill Helkie, Dale Henderson, David Howard, Karen Johnson, Cathy Mann, and Ted Truman for useful comments and guidance. This paper represents the views of the authors and should not be interpreted as reflecting the views of the Board of Governors or other members of its staff.

interest and economic growth in Germany, as well as the path of German prices and other nominal variables. The impact of German economic unification on other countries is relatively modest, as the additional investment demand is not large relative to global investment and a disproportionate share of that investment demand is met by domestic German savings.

The analysis of this paper focuses on the medium- and long-run aspects of German economic integration. No detailed model of the East German economy is used. As a result, the simulations presented here shed little light on a number of important short-run adjustment questions, such as transitional unemployment that might be caused by the privatization of East German state-owned enterprises, and short-run disruptions to the market for Deutschemark financial assets that might result from the establishment of a German monetary union. What these simulations capture most accurately is the long-lasting impact of the fundamental change in the balance of savings and investment -- both within Germany and outside Germany -- that would result from the incorporation of East Germany into the West German economy.

#### THE SIMULATION FRAMEWORK

Because East German voters heavily favored parties that advocate the immediate establishment of close economic and political ties with West Germany, the economic aspects of unification can be expected to happen very quickly. The fundamental reforms necessary for economic integration probably will be in place by mid-1990. The basic elements to these reforms are the following: price reform, allowing prices to be determined by market forces with a sharp reduction in distortionary taxes and subsidies; the elimination of restrictions on foreign investment; the elimination of barriers to foreign trade; privatization of the housing stock and, possibly, major state-owned enterprises; and a banking reform. A monetary union of

the two Germanys is expected to occur as soon as these reforms are implemented. Although a formal political union may not occur in 1990, this paper treats the East and West German governments as a single entity after economic unification has occurred.

To quantify the impact of economic integration, the analysis employs the Federal Reserve Board staff's MX3 macroeconometric model.<sup>2</sup> MX3 is a medium-sized quarterly model of the United States, West Germany, and Japan. The model is closed with a rest-of-world (ROW) sector that is specified as a fourth country in the model.<sup>3</sup> MX3 has a theoretical structure that is well-suited to exploring the effects of fundamental changes in the productive sector of an economy. The qualitative conclusions are consistent with standard neoclassical growth theory. However, by using actual data and estimated parameters, we are able to reach quantitative predictions as well. An important feature of MX3 is that model-consistent expectations play a central role in the consumption, investment, exchange rate, and price contract equations.

In the simulations of this paper both the announcement and the consummation of economic unification are assumed to occur in the first quarter of 1990.<sup>4</sup> Because of the forward-looking expectations in MX3, the announce-

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2. For a description of the MX3 model, see Gagnon [1989]. The only significant change to MX3 for this paper is the adoption of a four-quarter staggered contracts model for price adjustment.

3. One of the drawbacks of our analysis is that we could not distinguish between the effects of German integration on other European countries and its effects on countries outside of Europe, the United States, and Japan. Of particular interest is the issue of monetary policy in the countries of the European Monetary System, which effectively have pegged their exchange rates to the Deutschemark.

4. German unification first became a tangible possibility in the fourth quarter of 1989, but there was considerable uncertainty concerning when it might be achieved. Although some uncertainty remained about unification as of the end of the first quarter of 1990, the basic issues appeared to have been largely resolved in 1990:Q1.

ment of a future event can have an immediate impact on the economy that is different from the impact of the event itself. It would be reasonable therefore to conduct simulations with unification announced in 1990:Q1, but implemented only in, say, 1990:Q2 or 1990:Q3. We decided not to follow this approach because we felt that the associated technical problems were too great relative to any gains we could expect from its more realistic treatment of the timing of unification.

Economic unification is modeled as an exogenous increase in the capital stock and labor force of the West German sector of MX3. The stock of government liabilities outstanding and Germany's net foreign asset position also are adjusted to reflect the financial aspects of unification. The implicit assumption is that the behavioral relationships estimated for West Germany will reasonably approximate the economic behavior of the new German economic union.

Two basic modifications to the structure of the West German sector of the MX3 model were necessary to incorporate East Germany sensibly. In MX3 productive capacity is modeled as a Cobb-Douglas function of capital and labor with Hicks-neutral technical progress:

$$(1) \quad CAP = Q K^{\alpha} L^{1-\alpha}.$$

In equation 1, CAP refers to capacity output, Q indexes the level of technology, K represents the stock of capital, L is the labor force, and  $\alpha$  is the elasticity of output with respect to capital.

One approach to modelling the unification of East and West Germany simply would augment the West German factor supplies with the estimated values of East German capital and labor. This approach implicitly assumes

that capital and/or labor are free to move throughout Germany immediately after unification to equalize the capital-labor ratios of the two regions.

A more reasonable alternative is to assume that capital stocks and labor forces cannot adjust instantaneously to equalize the capital-labor ratio throughout Germany upon unification. Moreover, the government may take steps to discourage East German laborers from migrating to the West.<sup>5</sup> Thus, we assume that the East German labor force remains in the East, and that capital gradually flows eastward until the capital-labor ratios in both parts of Germany are equalized. Under this assumption, the production function for a unified Germany would take the following form:

$$(2) \quad CAP = Q_w K_w^\alpha L_w^{1-\alpha} + Q_e K_e^\alpha L_e^{1-\alpha}.$$

The subscripts denote the region in which the factor supplies are located. Equation 2 is the production function that was employed in this paper.

The assumption that the capital stocks of the two German regions remain separate necessitates a mechanism for allocating investment between them. With no adjustment costs, one would expect that all investment would flow eastward until capital-labor ratios were equalized across regions. (This conclusion follows from the fact that the marginal product of capital is inversely related to the capital-labor ratio.) However, there are likely to be adjustment costs associated with the rapid installation of capital in East Germany. These adjustment costs effectively reduce the return to installing capital in a given period. If the adjustment costs increase with

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5. For example, subsidies for East Germans who migrate to the West might be reduced and/or subsidies for East Germans who remain in the East might be increased. As the next section discusses, the simulation results are not sensitive to the size or structure of transfers between East and West Germans.

the rate of adjustment, then it may not be desirable to direct all investment eastward. Moreover, the rate of investment in East Germany will be negatively related to the capital-labor ratio in the East, as an increasing capital-labor ratio reduces the return to investment. Equation 3 presents a simple mathematical relationship that embodies these characteristics.

$$(3) \quad \Psi = \frac{L_e}{L_e + L_w} + \left( \frac{L_w}{L_e + L_w} \right) * \left\{ 1 - \left( \frac{K_e/L_e}{K_w/L_w} \right)^\theta \right\}.$$

$\Psi$  represents the share of total German investment that occurs in the East. In the long run,  $\Psi$  will equal the share of the labor force that lives in the East, the first term in equation 3. In the short run,  $\Psi$  will be higher by the amount represented by the second term in equation 3. This term is itself the product of two terms, the share of investment that will occur in the West in the long run and a fraction that falls toward zero as the capital-labor ratio in the East approaches that in the West from below. The parameter  $\theta$  affects the speed of adjustment of the East German capital stock. Higher values of  $\theta$  imply faster convergence of the two capital-labor ratios. In our simulations,  $\theta$  is chosen so that in the first period all fixed investment net of depreciation occurs in East Germany; West German investment is just sufficient to replace depreciating capital. In later periods, West German net investment gradually returns to its long-run level.

While equation 3 determines the *share* of total German investment that flows into East Germany, the *level* of total German investment is determined by the existing fixed investment equation for West Germany. In MX3 fixed investment depends on the difference between the desired and the actual capital stock. Desired capital is a function of current and future levels of output and the real interest rate. After unification, total German fixed



investment is determined by total German output, capital, and real interest rates.

#### CALIBRATING THE EAST GERMAN ECONOMY

In order to carry out this experiment it was necessary to estimate the appropriate values for a number of key variables in the East German economy.

##### Capital and Technology

In order to implement equation 2, assumptions must be made about the initial values for  $Q_e$  and  $K_e$  (in addition to assumptions about the supply of labor,  $L_e$ , which are described below). Unfortunately there are no reliable data that would allow one to estimate these variables directly. Official statistics suggest that the East German capital stock per capita measured in East German Marks is roughly equal to the capital stock per capita in West Germany measured in Deutschemarks (DM), but the uncertainty regarding the appropriate rate of exchange makes this comparison of little use.<sup>6</sup>

The one relevant piece of evidence that is available is that labor productivity in East German manufacturing appears to be about half of that in West Germany.<sup>7</sup> Whether or not this deficit reflects a deficiency in disembodied technology, captured in the variable  $Q_e$ , or in the level of capital, represented by  $K_e$ , is important in these simulations because it determines the amount of investment needed to raise productivity in East Germany to West German levels. For example, if the difference in labor productivity between East and West Germany reflects differences in disembodied technology, then it is reasonable to believe that the application of West German know-how, and the introduction of market incentives, could

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6. *Statistical Pocketbook of the German Democratic Republic*, 1989.

7. Deutsche Bank, 1989.

significantly increase East German productivity without any additional investment. Alternatively, if the gap in labor productivity reflects a shortage of capital, then a substantial volume of additional investment will be needed in East Germany. These two scenarios obviously would have very different impacts on West Germany and other industrialized countries.

In this paper we assume that lower labor productivity in East Germany reflects only a deficit in capital, that is, the technology factor,  $Q$ , is assumed to be identical in both parts of a united Germany. This somewhat extreme assumption does not reflect a literal belief that production technologies are currently identical in the two Germanys. Rather, it reflects the belief that, to a significant degree, inferior technologies used in East Germany are embodied in the existing capital stock, and therefore productivity in East Germany can be increased to West German levels only by replacing existing plant and equipment. West German businessmen who have visited East Germany have suggested that only a small portion of the existing capital stock could be converted for production of goods of western quality. For example, auto executives who are considering investing in East Germany have indicated that auto assembly plants in the East cannot be converted to production for the Western market and that the only economic alternative is to tear them down and build new plants from scratch.

Given this framework, the initial capital stock in East Germany was calibrated using equation 1 and assuming that  $Q$  and  $\alpha$  are the same in East Germany as the estimated values for West Germany in the MX3 model. This production function implies that if labor productivity in East Germany is one-half of that in West Germany, then the capital-labor ratio in East Germany is one-eighth of that in West Germany. Therefore, the level of business plant and equipment per worker in East Germany was assumed to be one-eighth of the comparable level in West Germany. The values of the

housing stock and government capital per worker were assumed, arbitrarily, to be one-half of the levels in West Germany. Consequently, the initial level of the East German capital stock, i.e., the sum of these components, was assumed to be 10.4 percent of the West German capital stock.

#### Labor Force

This study assumes that the East German labor force is of the same quality as the West German labor force. While this assumption may not be strictly correct, it is true that educational levels are similar in the two countries, and they share much in common culturally.

The population of East Germany is roughly one quarter that of West Germany. A greater proportion of women work in East Germany than in West Germany, so that the East German labor force is somewhat greater than one quarter of the West German labor force. In 1988 the labor force in East Germany was 8.8 million. But in 1989 340,000 East Germans emigrated to West Germany and roughly two thirds are thought to be of working age. Therefore, the initial East German labor force is assumed to be 8.6 million.

Detailed population projections are not available for East Germany. But in the absence of significant migration the working age population is expected to stay roughly constant for the foreseeable future. Accordingly, the simulations in this paper assume that the East German labor force remains at its current level.

#### Output

Under the assumptions for technology, capital, and labor force presented above, a united Germany would have 30.2 percent more workers, 10.4 percent more capital, and 20.7 percent more potential output than West Germany. It is worth noting that if equation 1 rather than equation 2 were used, united Germany's potential output would be 23.3 percent greater than West Germany's. While a 20.7 percent increase may seem close to the 23.3

percent increase associated with complete factor mobility, it actually represents an 11.2 percent difference in the productivity of East German factors of production.

#### Government Debt

The integration of East Germany into the West German economy will involve the distribution of the assets and liabilities of East and West Germany among various sectors of the new united Germany. The level and distribution of those assets and liabilities will affect the macroeconomy of the new German economic union. In considering the impact of this aspect of German integration it is useful to consider a simplified balance sheet of the consolidated public sector of East Germany.<sup>8</sup>

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8. The data on currency and bank deposits were published in *The Statistical Pocketbook of the German Democratic Republic*, 1989. Information on East German foreign assets was taken from *Semi-Annual Maturity Survey*, various issues.

This consolidated balance sheet hides some of the "financial engineering" that will be required in the process of economic reform in East Germany. For example, state-owned enterprises hold deposits at state-owned banks of 60 billion East German Marks and they have loans outstanding from those same banks of 260 billion East German Marks. (*Frankfurter Allgemeine Zeitung*, 27 March 1990) These are just offsetting claims between two components of the East German public sector and therefore are not important to the analysis presented in this paper. But, the manner in which these assets and liabilities are treated in the establishment of a monetary union may have a significant, if relatively short-lived, impact on German financial markets.

Balance Sheet of the Consolidated  
Public Sector of East Germany  
(billions)

Assets			Liabilities		
Land	--	?	Currency held by individuals	--	EGM 16
Capital	--	DM 640	Bank deposits held by individuals	--	EGM 152
Foreign exchange	--	US\$ 10	Hard currency foreign debt	--	US\$ 20
			Net worth*	--	DM 490

\* EGM liabilities converted at 1:1; US\$ values converted at 1.7DM/\$; does not include value of land.

There are three basic assets on this balance sheet: land; physical capital, including the plant and equipment of state-owned enterprises, the housing stock, and government capital; and foreign assets. On the liability side of the balance sheet there are also only three basic items: currency held by individuals, bank deposits of individuals, and foreign debts. The simplicity of this balance sheet reflects the relatively underdeveloped financial structure of East Germany. For example, the only claims that the East German private sector holds on the government are currency and deposits at state banks.

The liability side of the balance sheet is relatively well known. At the end of 1988 currency in circulation was 15.6 billion East German Marks and the deposits of individuals were 151.6 billion East German Marks. Claims on East Germany held by Western banks were \$20 billion. East Germany may have assets and liabilities vis-a-vis other East European countries as

well, but there are no publicly available data on those claims and so they were not taken into account.

It is much more difficult to value the asset side of this balance sheet. The East German government holds title to virtually all land in East Germany. We have no information on the value of this land, but it is undoubtedly substantial. The estimated value of capital, expressed in current Deutschemarks, reflects the assumptions on East German capital-labor ratios described above.

This simple balance sheet suggests that even under very conservative assumptions, the value of assets held by the East German government substantially exceeds its liabilities. This surplus reflects the concentration of the ownership of the means of production in the hands of the state in a socialist economy. The distribution of this surplus has not yet been determined, but it represents a potential source of finance for subsidies to East Germans in the new economic union.

In the simulations that follow it is assumed that the stock of government bonds initially increases by DM 184 billion compared with the existing West German level. This reflects two assumptions. First, East German Mark public sector liabilities are converted to DM at a rate of 1:1. Second, the government of the united Germany assumes the public sector liabilities of East Germany without taking any of the proceeds from privatization of the existing assets (except for the foreign exchange assets). In other words, it is assumed that the land and capital stock of East Germany are simply given to the residents of the new Germany.

The conversion of East German savings accounts and currency holdings and the distribution of East German land and capital will raise total private holdings of assets in Germany. These increased assets will not

raise total German wealth directly, however. In the MX3 model household wealth is computed by adding the discounted future income flows from labor, capital, transfers, and government bonds and subtracting the discounted future stream of taxes. By increasing private holdings of capital and government bonds, unification increases the future flow of profit and interest income to the private sector. But, by depriving the government of the future income from the capital stock and increasing the government's future interest payments, unification leads to higher future taxes and lower future subsidies for households if real government spending is held constant. In the absence of any increase in the capital stock, production technology, or economic efficiency of East Germany, unification and the privatization of East German assets would have no effect on total German wealth in MX3.

The distribution of land and capital between East and West German residents does affect the wealth and consumption of one region relative to the other. However, it does not affect aggregate consumption and saving behavior in the MX3 model because consumption is proportional to wealth in MX3, and the distribution of wealth across regions does not change aggregate wealth. Therefore we did not need to make any specific assumptions concerning the distribution of East German assets and liabilities across regions of unified Germany.

Some observers have expressed concern that transfers given to East Germans will lead to a consumption boom in East Germany. In this context, the neutrality of the MX3 model to the financial aspects of economic and monetary union may be unrealistic. However, economic integration undoubtedly will raise the permanent income of East German residents substantially due to expected future increases in the level and quality of

the capital stock. This higher expected future income ought to lead to increased consumption demand by East Germans, and, indeed, the model does predict a consumption boom if real long-term interest rates are held constant. But, it may be reasonable to expect an even larger increase in demand for consumer durables than MX3 would predict because MX3 does not correctly capture the nature of consumer durables as components of household wealth. It is reasonable to expect that East Germans will have a strong demand for consumer durables given their limited availability before integration. This effect may be offset by restrictions placed on the liquidity of East German savings accounts that have been converted to DM.

#### Money Supply

The manner in which monetary union is modeled in these simulations is limited somewhat by the structure of the monetary side of MX3. The only monetary aggregate in MX3 is the monetary base. In the previous section, we assumed that the new German government would replace East German currency and savings accounts with government debt.<sup>9</sup> Clearly, East German residents will want to hold some currency to conduct their transactions. We assume that the German central bank supplies sufficient monetary base (through open market operations) to satisfy the transactions demand of East Germans without causing inflation. This assumption implies an aggressive response of the central bank to incipient inflationary or deflationary pressures.

#### Prices and Wages

The simulations of this paper assume that prices and wages in East Germany are decontrolled prior to unification. Decontrol implies that prices for similar goods should be nearly identical in the East and in the

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9. Equivalently, the new German government could supply the East German banking system with government securities to back the savings accounts of East Germans.



West. Wage rates in each region should equilibrate at the marginal product of labor. The simulation results do not include any inflation or deflation due to one-time price changes in East Germany associated with unification.

While it may seem reasonable to assume instantaneous price adjustment for goods, it seems less reasonable to assume that East German wages will equilibrate instantaneously. However, there is some evidence that East German wages would not be grossly misaligned at a conversion rate of 1:1. In 1988, East German average wages in East German Marks were about half of West German average wages in DM. As discussed above, it also appears that East German labor productivity is roughly half that of West Germany.

#### THE SIMULATION EXPERIMENTS

In order to focus on the effects of German unification alone, the simulation results are expressed in terms of deviations from a baseline in which there is no unification. The behavior of unified Germany is expressed relative to the combined behavior of baseline East Germany and baseline West Germany. The simulation results are not sensitive to alternative baseline paths for the United States, Japan, Germany, or ROW, provided that the baseline East German variables maintain a constant proportionality to the baseline West German variables. The simulation results are sensitive to alternative baseline paths for East Germany *relative* to West Germany.

The assumed baseline values for key East German variables at yearend 1989 are presented in Table 1. In the baseline, the East German economy is assumed to grow at an annual rate of 0.5 percent less than the West German economy, reflecting a 0.5 percent annual labor force growth rate in West Germany and a constant labor force in East Germany. The baseline for unified Germany is simply the sum of the baselines for East and West

**Table 1**  
**Assumptions for Baseline East Germany**  
**Yearend 1989**

<u>East German Variable</u>	<u>Level</u>	<u>Percent of W. German Variable</u>
Technology Factor	9.6	100.0%
Labor Force (millions)	8.6	30.2
Capital Stock (80 DM, B)	516.5	10.4
Government Debt (DM, B)	184.2	36.9
Net Foreign Assets (US\$, B)	-10.0	-3.4
GDP (80 DM, B)	350.9	20.7
Consumption (80 DM, B)	197.5	20.7
Fixed Investment (80 DM, B)	72.5	20.7
Inventory Investment (80 DM, B)	3.9	20.7
Government Exp. (80 DM, B)	77.0	23.0
Exports* (80 DM, B)	0.0	0.0
Imports* (80 DM, B)	0.0	0.0
Current Account Balance (US\$, B)	0.0	0.0

\* In 1988 the value of East German trade with OECD countries (other than West Germany) was only about 1 percent of West German trade with OECD countries. (OECD, *Monthly Statistics of Foreign Trade*)

Germany.<sup>10</sup> It should be noted that the baseline assumption of equal productive technologies in the two Germanys may not be an accurate description of their relative position prior to unification. As discussed in the previous section, this assumption was made jointly with the assumed capital stock to yield a level of East German productivity consistent with independent studies. To the extent that our baseline East German technology is too high, our baseline East German capital stock is probably too low, and our baseline level of output in East Germany still may be appropriate.

The simulations were implemented by augmenting the time series data for West Germany with the assumed values for East Germany at the end of the last quarter prior to simulation, 1989:Q4.<sup>11</sup> In addition, government spending is raised by a sufficient amount to keep per worker expenditures in unified Germany equal to per worker expenditures in baseline West Germany. The primary effect of this shock is to increase the marginal product of capital in unified Germany relative to baseline West Germany. Investment in a unified Germany increases until the capital-labor ratio returns to the equilibrium level for West Germany.

Fiscal policy is modelled as an exogenous path for real government spending and a tax reaction function in every country. Tax rates in every country are assumed to adjust gradually to maintain a constant ratio of national debt to national income. Each country's central bank uses the short-term interest rate to minimize deviations of the price level from its baseline path. In addition to the principal scenario, several simulations

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10. No assumptions are made about baseline prices and interest rates in East Germany. All simulations assume that prices are decontrolled in East Germany prior to unification.

11. No adjustments were made to the ROW sector because this sector does not include data from East Germany.

have been conducted to explore the sensitivity of the results to the particular assumptions made about the East German economy and about economic policy in a unified Germany.

#### The Principal Simulation

Table 2 presents the results of the principal simulation of German unification in MX3. In the principal simulation the West German sector of MX3 is augmented by the baseline values for East Germany presented in Table 1 and real government expenditure per worker is maintained at the level of baseline West Germany. The parameter  $\theta$  in the investment share relation (equation 3) is set to 0.33. This value of  $\theta$  implies that 51 percent of total German investment occurs in East Germany immediately after unification. (The remaining 49 percent is just sufficient to replace depreciating capital in West Germany.) Over time the share of investment that occurs in East Germany gradually declines toward its long-run value of 30 percent.

Since we are concerned about the medium- to long-run effects of unification, we present annual results only. Except for the last line under the German heading, all of the results are expressed in terms of deviations from baseline. The line labeled "Cap.-Lab. Ratio" represents the East German capital-labor ratio as a fraction of the West German capital-labor ratio in the simulation.

Table 2 shows that fixed investment in Germany increases by 1 percent of GDP in the first year of unification, rising to 3.8 percent of GDP by the sixth year and then declining slowly thereafter. Output initially increases by less than the increase in investment, but it rises steadily over time as the capital stock increases. The GNP deflator is kept close to its baseline value, but short-term interest rates rise steadily over the first few years. The long-term interest rate (10-year government bond) jumps up by 60 basis

Table 2

MX3 Simulation of German Unification

	90	91	92	93	94	95	96	97	98	99
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GERMANY										
Real GDP (%).....	0.7	1.4	2.1	2.8	3.3	3.8	4.3	4.8	5.1	5.5
Fixed Inv. (% of GDP).....	1.0	2.3	3.1	3.5	3.7	3.8	3.7	3.6	3.5	3.3
Priv. Cons. (% of GDP).....	-0.2	-0.0	0.1	0.4	0.6	0.9	1.2	1.4	1.7	1.9
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-1.3	-2.0	-2.3	-2.3	-2.3	-2.1	-1.9	-1.6	-1.4	-1.1
Infl. Rate (PGNP) (+/-)....	0.3	0.2	0.1	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1
S.t. Int. Rate (+/-).....	0.3	0.6	0.7	0.8	0.8	0.7	0.7	0.6	0.5	0.4
L.t. Int. Rate (+/-).....	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.2	0.2
Nom. Exch. Rate (% \$/DM)...	7.8	7.5	7.2	6.6	5.9	5.2	4.5	3.8	3.2	2.6
Current Bal. (US\$,B)(+/-)...	5.8	-8.8	-14.9	-19.5	-23.1	-25.8	-27.6	-28.6	-29.0	-28.9
Fixed Inv. (US\$,B)(+/-)....	42.0	69.2	88.6	102.4	111.7	117.7	121.4	123.7	125.0	125.9
Cap.-lab. Ratio (E/W).....	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9
UNITED STATES										
Real GDP (%).....	0.2	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.3	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.0
Current Bal. (US\$,B)(+/-)...	7.7	13.6	14.6	14.7	14.2	13.2	12.0	10.6	9.2	7.8
JAPAN										
Real GDP (%).....	-0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fixed Inv. (% of GDP).....	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
Priv. Cons. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Infl. Rate (PGNP) (+/-)....	-0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	-0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.0	-0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Nom. Exch. Rate (% \$/Yen)...	0.5	0.8	1.1	1.4	1.6	1.6	1.6	1.6	1.5	1.5
Real Net Exp. (% of GDP)...	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2	-0.1	-0.0	0.0
Current Bal. (US\$,B)(+/-)...	-2.0	-2.4	-3.1	-3.7	-4.2	-4.3	-3.8	-2.6	-0.7	1.8
REST OF WORLD										
Real GDP (%).....	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1
Fixed Inv. (% of GDP).....	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1
Priv. Cons. (% of GDP).....	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
Infl. Rate (PGNP) (+/-)....	0.0	0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nom. Exch. Rate (% \$/Row)...	1.1	1.0	0.8	0.6	0.5	0.4	0.4	0.4	0.4	0.5
Real Net Exp. (% of GDP)...	0.1	0.4	0.5	0.6	0.7	0.7	0.6	0.5	0.4	0.3
Current Bal. (US\$,B)(+/-)...	-11.4	-2.3	3.3	8.6	13.2	16.9	19.4	20.6	20.5	19.2

Percent (%) and Absolute (+/-) Deviations from Baseline

points at the announcement of unification. Because the price level moves so little, these higher nominal interest rates in Germany are equivalent to higher real interest rates. The higher real rates are consistent with a higher marginal productivity of capital in the unified Germany.

Higher interest rates in Germany cause an immediate appreciation of the DM by 7.8 percent. The appreciated DM, combined with higher aggregate demand in Germany, causes German real net exports to drop by 1.3 percent of output relative to baseline in 1990. German net exports drop by even more in subsequent years. In real terms, roughly half of the increased demand for fixed investment and government purchases is met by reduced net exports. The remaining half is met by higher output, lower consumption (at first), and lower inventory investment.

The appreciation of the DM implies that a much smaller fraction of the increased demand is met by reduced exports in nominal terms. The German current account balance actually improves in the first year due to J-curve effects from the appreciated DM. The current account quickly turns around, however, and eventually declines by \$29 billion per annum relative to baseline. The decline in Germany's current account balance is small relative to the \$125 billion in extra investment each year associated with unification.

According to the simulation, the capital-labor ratio in East Germany reaches 90 percent of the capital-labor ratio in West Germany after 10 years. Roughly half of the adjustment occurs in the first three years. Some of this movement, however, represents a decline in the capital-labor ratio of West Germany relative to baseline as investment is diverted from West to East Germany. In the long run, the capital-labor ratio of a unified Germany will converge to that of baseline West Germany as interest rates return to their baseline values.

To bring East Germany immediately up to the baseline capital-labor ratio of West Germany would require approximately \$850 billion in fixed investment in 1990. The annual depreciation of this extra capital stock would total about \$40 billion (1990 dollars). However, in the simulation results, the increased investment is spread over several years. Although the additional fixed investment in Germany continues to grow in nominal dollars throughout the simulation, in real terms the extra fixed investment peaks in 1995.

If united Germany were to achieve the baseline capital-labor ratio of West Germany by 1999, its potential output would be 6.4 percent higher than the combined potential output of East and West Germany under the baseline. According to Table 2 a united Germany would have a real GDP of 5.5 percent above baseline in 1999. Thus, in the principal simulation of this paper, the adjustment process in Germany is 86 percent completed within 10 years of unification.

The primary channels by which German unification affects other countries appear to be the appreciated DM and the higher aggregate demand in Germany, which improve net exports and the current account in the United States and ROW. Curiously, the Japanese do not share in the German import boom. This result probably stems from the very tiny share of Germany in Japanese exports, combined with a slight reduction in U.S. and ROW aggregate demand. It is also interesting that interest rates rise by very little outside of Germany. Apparently, the increased demand on world savings due to German unification is relatively small.

Real output in the United States rises slightly with German unification, but U.S. output drops slightly in the long run due to several years of lower fixed investment. Both consumption and investment decline slightly in the United States because of the increase in the real rate of interest

and the reduction of real wealth due to the adverse terms-of-trade shock. The reduction in U.S. output persists even after the interest rate returns to its baseline value because it takes many years for the capital stock to return to its baseline level. In the long run, U.S. output, consumption, and investment return to their baseline levels. The improvement in the U.S. current account peaks at roughly \$15 billion per annum after three years.

Output is not affected in Japan, but it drops slightly in ROW. ROW consumption and investment drop slightly more than U.S. consumption and investment despite the negligible movement of ROW interest rates. This response is probably due to larger wealth effects from the terms-of-trade shock, since trade is a larger fraction of the ROW economy. The reduction of domestic ROW demand makes room for a larger increase in ROW real net exports than is experienced by the United States.

#### Alternative Simulations

Tables 3 through 7 present the results of alternative simulations of German unification. In each of these alternative scenarios, one of the maintained assumptions of the principal scenario is altered.<sup>12</sup>

Table 3 considers the case in which the East German capital stock is only half the assumed size in Table 2.<sup>13</sup> In this case, East German potential output is only 16.3 percent of West German output, rather than 20.7 percent as in the other simulations. Not surprisingly, the effects on

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12. An additional simulation, not presented here, considers the impact of the migration of one percent of the East German labor force into West Germany in each of the years 1990-1994. This simulation slightly speeds up the convergence of East and West German capital-labor ratios, but otherwise the effects on united Germany and the other countries were nearly identical to those of the principal simulation.

13. This assumption probably would affect one's assessment of the baseline path of East Germany without unification. However, to facilitate comparison across alternative simulations of unification, the baseline for this table is the same as that for Table 2.



Table 3

MX3 Simulation of German Unification  
Initial E. German Capital: 258B DM

	90	91	92	93	94	95	96	97	98	99
<hr/>										
GERMANY										
Real GDP (%).....	-2.3	-1.0	0.3	1.4	2.4	3.2	3.8	4.4	4.9	5.2
Fixed Inv. (% of GDP).....	0.5	2.2	3.3	3.9	4.2	4.3	4.2	4.1	3.9	3.7
Priv. Cons. (% of GDP).....	-2.0	-1.4	-1.0	-0.7	-0.3	0.1	0.4	0.8	1.1	1.4
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-1.9	-2.9	-3.1	-3.0	-2.7	-2.4	-2.1	-1.8	-1.5	-1.2
Infl. Rate (PGNP) (+/-)....	0.3	0.1	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	0.3	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.6
L.t. Int. Rate (+/-).....	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.3
Nom. Exch. Rate (% \$/DM)...	10.7	10.0	9.2	8.2	7.1	6.2	5.3	4.4	3.7	3.1
Current Bal. (US\$,B)(+/-)...	6.8	-15.6	-23.7	-28.5	-31.3	-32.8	-33.6	-34.1	-34.4	-34.7
Fixed Inv. (US\$,B)(+/-)....	40.6	74.9	98.6	115.4	126.9	134.4	138.9	141.5	142.6	142.7
Cap.-Lab. Ratio (E/W).....	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9
UNITED STATES										
Real GDP (%).....	0.2	0.1	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.3	0.5	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.1
Current Bal. (US\$,B)(+/-)...	8.1	15.3	16.9	17.3	17.2	17.0	16.6	16.1	15.3	14.4
JAPAN										
Real GDP (%).....	-0.1	-0.1	-0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.1
Fixed Inv. (% of GDP).....	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Priv. Cons. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Infl. Rate (PGNP) (+/-)....	-0.1	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.0	0.0	0.0
L.t. Int. Rate (+/-).....	-0.1	-0.1	-0.1	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0
Nom. Exch. Rate (% \$/Yen)...	1.0	1.1	1.1	1.0	1.0	0.9	0.9	1.0	1.0	1.1
Real Net Exp. (% of GDP)...	-0.1	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	-0.0	0.0	0.1
Current Bal. (US\$,B)(+/-)...	-1.1	-4.1	-6.3	-7.2	-6.8	-5.6	-3.8	-1.6	0.7	3.3
REST OF WORLD										
Real GDP (%).....	0.2	0.2	0.1	-0.1	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
Fixed Inv. (% of GDP).....	-0.1	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2
Priv. Cons. (% of GDP).....	-0.2	-0.4	-0.5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.4	-0.4
Infl. Rate (PGNP) (+/-)....	0.1	0.1	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	0.1	0.2	0.3	0.2	0.2	0.1	0.1	0.0	0.0	-0.0
L.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.0	-0.0	-0.0
Nom. Exch. Rate (% \$/Row)...	0.6	0.7	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.7
Real Net Exp. (% of GDP)...	0.4	0.8	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2
Current Bal. (US\$,B)(+/-)...	-13.9	4.4	13.1	18.4	20.9	21.4	20.9	19.7	18.4	17.0

Percent (%) and Absolute (+/-) Deviations from Baseline

Table 4

MX3 Simulation of German Unification  
Initial E. German Technology: 8.7  
Initial E. German Capital: 758B DM

	90	91	92	93	94	95	96	97	98	99
<hr/>										
GERMANY										
Real GDP (%).....	0.5	1.1	2.1	3.1	4.1	4.5	4.8	5.2	5.5	5.8
Fixed Inv. (% of GDP).....	0.6	1.5	2.3	2.8	3.2	3.3	3.3	3.3	3.2	3.1
Priv. Cons. (% of GDP).....	-0.3	-0.1	0.3	0.8	1.4	1.5	1.7	1.9	2.1	2.3
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-1.0	-1.6	-1.8	-1.8	-1.8	-1.7	-1.6	-1.4	-1.2	-1.0
Infl. Rate (PGNP) (+/-)....	0.3	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	0.3	0.5	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.3
L.t. Int. Rate (+/-).....	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.1
Nom. Exch. Rate (% \$/DM)...	6.1	5.9	5.7	5.3	4.9	4.4	3.9	3.4	2.8	2.4
Current Bal. (US\$,B)(+/-)...	4.9	-6.0	-10.4	-13.9	-16.7	-19.1	-21.0	-22.2	-22.8	-22.9
Fixed Inv. (US\$,B)(+/-)....	30.2	49.5	66.7	82.3	95.5	103.0	108.3	111.9	114.5	116.4
Cap.-Lab. Ratio (E/W).....	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9
UNITED STATES										
Real GDP (%).....	0.2	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.0
Priv. Cons. (% of GDP).....	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.3	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.0	0.0
Current Bal. (US\$,B)(+/-)...	7.0	11.7	12.4	12.4	12.0	10.9	9.6	8.1	6.6	5.1
JAPAN										
Real GDP (%).....	0.0	0.1	0.1	0.1	0.0	0.0	-0.0	0.0	0.0	0.0
Fixed Inv. (% of GDP).....	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
Priv. Cons. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.0
Infl. Rate (PGNP) (+/-)....	-0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	-0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	-0.0	-0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Nom. Exch. Rate (% \$/Yen)...	0.5	0.8	1.1	1.4	1.6	1.7	1.7	1.7	1.7	1.6
Real Net Exp. (% of GDP)...	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.0	0.0
Current Bal. (US\$,B)(+/-)...	-1.7	-2.1	-2.4	-2.8	-3.1	-3.0	-2.4	-1.3	0.5	2.9
REST OF WORLD										
Real GDP (%).....	-0.1	-0.1	-0.1	-0.1	-0.0	0.0	0.0	0.0	-0.0	-0.0
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.1
L.t. Int. Rate (+/-).....	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nom. Exch. Rate (% \$/Row)...	1.0	0.9	0.8	0.6	0.5	0.4	0.3	0.3	0.4	0.4
Real Net Exp. (% of GDP)...	0.0	0.2	0.3	0.4	0.5	0.5	0.5	0.4	0.4	0.3
Current Bal. (US\$,B)(+/-)...	-10.1	-3.6	0.5	4.3	7.8	11.2	13.8	15.4	15.7	14.8

Percent (%) and Absolute (+/-) Deviations from Baseline

Table 5

MX3 Simulation of German Unification  
Capital Stock Convergence:  $\theta=0.15$

	90	91	92	93	94	95	96	97	98	99
<hr/>										
GERMANY										
Real GDP (%).....	0.6	1.3	2.0	2.7	3.3	3.8	4.2	4.6	5.0	5.3
Fixed Inv. (% of GDP).....	1.0	2.2	2.9	3.4	3.6	3.7	3.6	3.5	3.4	3.3
Priv. Cons. (% of GDP).....	-0.2	-0.1	0.1	0.3	0.6	0.9	1.1	1.4	1.6	1.9
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-1.3	-2.0	-2.2	-2.2	-2.2	-2.0	-1.9	-1.7	-1.4	-1.2
Infl. Rate (PGNP) (+/-)....	0.2	0.1	0.1	0.1	0.0	-0.0	-0.0	-0.1	-0.1	-0.1
S.t. Int. Rate (+/-).....	0.2	0.5	0.7	0.8	0.8	0.8	0.7	0.7	0.6	0.5
L.t. Int. Rate (+/-).....	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.2	0.2
Nom. Exch. Rate (% \$/DM)...	8.0	7.6	7.1	6.6	6.0	5.3	4.7	4.0	3.4	2.9
Current Bal. (US\$,B)(+/-)...	5.8	-9.1	-14.5	-18.4	-21.6	-24.2	-26.4	-28.1	-29.2	-29.9
Fixed Inv. (US\$,B)(+/-)....	41.5	66.9	85.5	99.3	109.0	115.8	120.3	123.2	125.2	126.4
Cap.-Lab. Ratio (E/W).....	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8
UNITED STATES										
Real GDP (%).....	0.2	0.1	0.0	-0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.3	0.5	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.0
Current Bal. (US\$,B)(+/-)...	7.8	13.6	14.8	15.3	15.2	14.6	13.7	12.4	10.9	9.3
JAPAN										
Real GDP (%).....	-0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Fixed Inv. (% of GDP).....	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0
Priv. Cons. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Infl. Rate (PGNP) (+/-)....	-0.1	0.0	0.1	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	-0.1	-0.1	-0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.0
Nom. Exch. Rate (% \$/Yen)...	0.3	0.3	0.6	0.9	1.2	1.4	1.5	1.6	1.6	1.6
Real Net Exp. (% of GDP)...	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.0
Current Bal. (US\$,B)(+/-)...	-2.5	-2.8	-2.7	-2.5	-2.3	-2.0	-1.6	-0.8	0.5	2.4
REST OF WORLD										
Real GDP (%).....	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
Fixed Inv. (% of GDP).....	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1
Priv. Cons. (% of GDP).....	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	0.0	0.1	0.1	0.0	-0.0	-0.0	-0.1	-0.0	-0.0	0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0
Nom. Exch. Rate (% \$/Row)...	1.1	1.2	1.1	1.0	0.8	0.6	0.5	0.4	0.4	0.4
Real Net Exp. (% of GDP)...	0.1	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.4	0.4
Current Bal. (US\$,B)(+/-)...	-11.0	-1.6	2.4	5.6	8.6	11.6	14.3	16.5	17.8	18.1

Percent (%) and Absolute (+/-) Deviations from Baseline

Table 6

MX3 Simulation of German Unification  
DM Pegged to US Dollar

	90	91	92	93	94	95	96	97	98	99
<hr/>										
GERMANY										
Real GDP (%).....	4.0	5.0	4.6	4.2	4.2	4.4	4.7	5.0	5.3	5.6
Fixed Inv. (% of GDP).....	2.1	4.0	4.6	4.6	4.4	4.1	3.8	3.6	3.3	3.1
Priv. Cons. (% of GDP).....	0.5	0.8	0.7	0.7	0.8	1.0	1.2	1.5	1.7	1.9
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-0.1	-0.9	-1.8	-2.2	-2.2	-2.0	-1.7	-1.4	-1.1	-0.8
Infl. Rate (PGNP) (+/-)....	4.5	2.6	0.6	-0.5	-0.9	-1.0	-0.9	-0.8	-0.7	-0.6
S.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.1	0.1	0.0	-0.0	-0.0	-0.0	-0.0
L.t. Int. Rate (+/-).....	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0
Nom. Exch. Rate (% \$/DM)...	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Current Bal. (US\$,B)(+/-)...	2.1	2.3	-5.3	-13.7	-19.4	-22.2	-23.1	-22.8	-22.0	-20.9
Fixed Inv. (US\$,B)(+/-)....	46.9	95.4	118.3	126.6	127.8	126.0	123.3	120.2	117.4	114.9
Cap.-Lab. Ratio (E/W).....	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9
UNITED STATES										
Real GDP (%).....	0.1	0.1	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	0.1	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0
S.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.0	-0.0	-0.0
L.t. Int. Rate (+/-).....	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.2	0.3	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.1
Current Bal. (US\$,B)(+/-)...	6.3	10.1	12.0	13.2	13.3	12.8	11.8	10.5	9.1	7.5
JAPAN										
Real GDP (%).....	-0.1	-0.1	-0.1	-0.0	0.0	0.1	0.1	0.1	0.1	0.1
Fixed Inv. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
Priv. Cons. (% of GDP).....	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Infl. Rate (PGNP) (+/-)....	-0.1	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1	-0.0	0.0	0.0
L.t. Int. Rate (+/-).....	-0.1	-0.1	-0.1	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0
Nom. Exch. Rate (% \$/Yen)...	0.8	0.9	1.1	1.3	1.6	1.8	2.0	2.1	2.1	2.1
Real Net Exp. (% of GDP)...	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.0	0.0
Current Bal. (US\$,B)(+/-)...	-0.4	-1.6	-2.7	-3.4	-3.4	-2.7	-1.6	-0.0	1.8	4.1
REST OF WORLD										
Real GDP (%).....	-0.1	0.0	0.1	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
Fixed Inv. (% of GDP).....	0.0	0.0	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1
Priv. Cons. (% of GDP).....	0.0	-0.0	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2
Infl. Rate (PGNP) (+/-)....	-0.0	0.1	0.1	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
S.t. Int. Rate (+/-).....	-0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.0	-0.0
L.t. Int. Rate (+/-).....	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.0	-0.0	-0.0
Nom. Exch. Rate (% \$/Row)...	0.5	0.6	0.8	0.9	1.0	0.9	0.9	0.8	0.7	0.6
Real Net Exp. (% of GDP)...	-0.2	0.0	0.3	0.5	0.5	0.5	0.4	0.3	0.2	0.1
Current Bal. (US\$,B)(+/-)...	-8.1	-10.8	-4.0	3.9	9.4	12.1	12.9	12.3	11.0	9.3

Percent (%) and Absolute (+/-) Deviations from Baseline

Table 7

MX3 Simulation of German Unification  
Target Price Rises 3% in Germany

	90	91	92	93	94	95	96	97	98	99
<hr/>										
<b>GERMANY</b>										
Real GDP (%).....	1.2	2.3	3.1	3.5	4.0	4.4	4.9	5.2	5.5	5.8
Fixed Inv. (% of GDP).....	1.2	2.7	3.5	3.9	4.0	3.9	3.8	3.7	3.5	3.4
Priv. Cons. (% of GDP).....	-0.0	0.2	0.4	0.5	0.7	1.0	1.3	1.6	1.9	2.1
Gov't Exp. (% of GDP).....	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
Real Net Exp. (% of GDP)...	-1.2	-1.8	-2.0	-2.1	-2.0	-1.8	-1.6	-1.4	-1.3	-1.1
Infl. Rate (PGNP) (+/-)....	1.6	1.2	0.6	0.2	0.0	-0.0	-0.0	-0.0	-0.0	-0.1
S.t. Int. Rate (+/-).....	1.5	0.6	0.2	0.7	0.8	0.7	0.7	0.6	0.6	0.5
L.t. Int. Rate (+/-).....	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.2	0.2
Nom. Exch. Rate (% \$/DM)...	6.3	4.8	4.1	3.5	2.8	2.1	1.5	1.0	0.6	0.2
Current Bal. (US\$,B)(+/-)...	4.6	-8.5	-12.7	-16.9	-20.0	-21.6	-22.5	-23.2	-24.1	-25.0
Fixed Inv. (US\$,B)(+/-)....	43.8	74.6	96.2	109.7	117.2	122.1	125.7	128.3	130.3	131.9
Cap.-Lab. Ratio (E/W).....	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9
 <b>UNITED STATES</b>										
Real GDP (%).....	0.2	0.1	0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Infl. Rate (PGNP) (+/-)....	0.0	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0
S.t. Int. Rate (+/-).....	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1
L.t. Int. Rate (+/-).....	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Real Net Exp. (% of GDP)...	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.1
Current Bal. (US\$,B)(+/-)...	8.2	12.7	13.6	14.4	14.8	14.7	14.3	13.7	12.9	11.9
 <b>JAPAN</b>										
Real GDP (%).....	-0.1	-0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Fixed Inv. (% of GDP).....	0.0	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0
Priv. Cons. (% of GDP).....	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Infl. Rate (PGNP) (+/-)....	-0.1	-0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	-0.0
S.t. Int. Rate (+/-).....	-0.1	-0.2	-0.2	-0.2	-0.1	-0.0	0.1	0.1	0.1	0.1
L.t. Int. Rate (+/-).....	-0.0	-0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0
Nom. Exch. Rate (% \$/Yen)...	0.6	0.4	0.3	0.4	0.5	0.6	0.8	1.0	1.1	1.2
Real Net Exp. (% of GDP)...	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	-0.0	0.0	0.0	0.1
Current Bal. (US\$,B)(+/-)...	-1.7	-3.6	-4.1	-3.5	-2.2	-0.6	1.2	3.0	4.9	6.9
 <b>REST OF WORLD</b>										
Real GDP (%).....	0.0	-0.0	-0.1	-0.2	-0.3	-0.4	-0.3	-0.3	-0.2	-0.2
Fixed Inv. (% of GDP).....	-0.0	-0.1	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1
Priv. Cons. (% of GDP).....	-0.1	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2
Infl. Rate (PGNP) (+/-)....	0.1	0.1	0.0	-0.0	-0.1	-0.1	-0.0	-0.0	-0.0	0.0
S.t. Int. Rate (+/-).....	0.1	0.2	0.2	0.2	0.1	0.0	-0.0	-0.1	-0.1	-0.1
L.t. Int. Rate (+/-).....	0.1	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Nom. Exch. Rate (% \$/Row)...	0.6	0.9	1.1	1.2	1.2	1.1	1.0	0.9	0.8	0.7
Real Net Exp. (% of GDP)...	0.2	0.3	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2
Current Bal. (US\$,B)(+/-)...	-11.1	-0.5	3.2	6.0	7.4	7.4	7.0	6.6	6.3	6.2

Percent (%) and Absolute (+/-) Deviations from Baseline

Germany are similar to, but more extreme than, those of Table 2. Long-term interest rates rise by 70 basis points, the DM appreciates 10.7 percent, the current account decreases by \$35 billion, and investment rises by \$143 billion. However, the effects on the United States are practically identical to those of Table 2, except that the current account increases by somewhat more in the long run. In the medium run, most of the extra German demand falls on ROW. The slight negative effect on Japanese exports is even larger in Table 3 than Table 2.

Table 4 considers the possibility that East German production technology is initially 13 percent below that of West Germany. The East German capital stock is scaled up to retain an initial East German potential output that is 20.7 percent of West Germany's. The level of East German technology steadily approaches that of West Germany. Convergence is achieved after four years. The primary effect of these assumptions is to reduce the cumulative investment desired in East Germany. The increased fixed investment reaches only \$115 billion and the current account declines by only \$23 billion. All the effects on the other countries are correspondingly reduced.

Table 5 considers the implications of assuming a lower allocation of investment into East Germany, as parameterized by  $\theta$  in equation 3. The primary effect is to retard the convergence of capital-labor ratios in East and West Germany. While East Germany does not grow as fast as in the principal scenario, West Germany does not decline below baseline as much as in the principal scenario, leaving the aggregate behavior of Germany quite similar to that observed in Table 2. The effect on the aggregate German economy is to reduce slightly the initial output, investment, and interest rate increases associated with unification. The effects on other countries are quite similar to those of Table 2.

Table 6 presents the results of a simulation in which Germany targets the \$/DM exchange rate at its baseline value. This scenario effectively ties the U.S. and German interest rates together. The effect on Germany is significantly higher inflation during the first two years. With higher inflation and a fixed nominal interest rate, the real short-term interest rate drops sharply in Germany. The real long-term interest rate does not drop by as much as the short-term interest rate because agents expect a small, but sustained, deflation after 1992. Consumption, investment, and output in Germany are much higher in the first few years of this simulation than in the principal scenario. Despite the fixed nominal exchange rate, the German real exchange rate in this simulation rises by almost as much as in the principal scenario due to the higher German price level. The German current account declines by \$7 billion less than in Table 2, and most of this reduction is sustained by ROW.

Finally, Table 7 presents the results of a simulation in which the German central bank allows its price level target to rise permanently by 3 percentage points. The increase in the target is phased in over the first three years. In most respects, the results of this simulation fall in between those of Table 2 and Table 6. There is some inflation in Germany during the first three years, but this inflation is less severe than the inflation that occurs when the DM is pegged to the dollar. The changes in output, investment, and net exports also lie between those of Table 2 and Table 6. The one notable difference of this simulation is that the short-term interest rate in Germany rises by much more in the first year than in any other simulation, but this increase is very short-lived. In the second year the short-term interest rate is the same in Table 7 as in Table 2. The effects on the other countries are quite similar in Table 2 and Table 7. One puzzling exception is that the ROW current account balance is lower, and

the Japanese current account balance is higher, than in the principal simulation.

#### CONCLUSION

The simulations of German unification in MX3 are consistent with standard neoclassical theory. By removing barriers to trade and investment and increasing the efficiency of the East German economy, integration spurs an investment boom in a unified Germany. Some of this investment demand is satisfied by countries outside of Germany, resulting in a sustained reduction in German real net exports and the current account balance.

One shortcoming of this paper's analysis of events within Germany after unification is its inability to quantify the adjustment costs and transition losses associated with the adoption of a new economic system in East Germany. For example, the necessary redeployment of labor and reorganization of enterprises may involve foregone output in East Germany in the near term. The responses of the German government to these developments also will affect economic outcomes in the short run. Therefore, we believe that this paper's strength lies in the analysis of economic forces that will remain operative in Germany for the medium to long run.

Internationally, the effects of German unification are shown to be relatively small, both because East Germany is small relative to the rest of the world, and because a large share of the increased investment in unified Germany is financed internally. However, the ongoing liberalization of Eastern Europe can be expected to have additional consequences for the United States and other countries. While the potential demands for investment are much larger in the other Eastern European countries as a group, the reduction in barriers and improvement in efficiency probably will proceed more slowly in those countries than the pace assumed for East Germany in



this paper. Thus, the immediate and medium-term impact of liberalization in Eastern Europe remains uncertain.

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