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Global Rebalancing with Gravity: Measuring the Burden of Adjustment

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This paper uses a 42-country model of production and trade to assess the implications of eliminating current account imbalances for relative wages, relative GDPs, real wages, and real absorption. How much relative GDPs need to change depends on flexibility of two forms: factor mobility and adjustment in sourcing of imports, with more flexibility requiring less change. At the extreme, U.S. GDP falls by 30 percent relative to the world's. Because of the pervasiveness of nontraded goods, however, most domestic prices move in parallel with relative GDP, so that changes in real GDP are small. [JEL F30, F31, F12]

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The United States' chronic current account deficit will inevitably reverse, and the reversal could be quite sudden. What would this reversal mean for the United States itself and for other countries? There are possible major effects on relative GDPs, real wages, and real absorption, not only across countries but also across individuals within countries.

We explore this question using a gravity model of trade and production. Because it represents the major component of trade, we focus on manufactures, asking what happens if manufacturing is the sector that bears the burden of

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rebalancing trade. We pursue this analysis using data for 2004 for the world, dividing it into 42 countries. Table 1 lists the countries, their GDPs, and three different deficit measures: the current account deficit, the overall trade deficit, and the deficit in manufactures.[1]

In 2004 the United States ran a current account deficit of $650 billion, nearly 6 percent of its GDP.[2] Aggregating the surpluses of the three largest surplus countries, Japan, Germany, and China, gets us to only $370 billion, little more than half the U.S. deficit. Note that for each of these four countries with the largest imbalances, the manufacturing deficit is by far the largest component of the overall deficit.

We build on previous work that integrates factor-market equilibrium into a model of international production and trade with heterogeneous goods and barriers to trade. Contributions include Eaton and Kortum (2002); Alvarez and Lucas (2007); and Chaney (forthcoming). We pursue a particular specification of gravity relationships, which we introduced in Dekle, Eaton, and Kortum (2007). Rather than estimating such a model in terms of levels, we specify the model in terms of *changes* from the current equilibrium. This approach allows us to calibrate the model from existing data on production and trade shares. We thereby finesse having to assemble proxies for bilateral resistance (for example, distance, common language, etc.) or inferring parameters of technology. A particular virtue is that we do not have to impose the symmetry in bilateral trade flows implied by these measures but spurned by the data. China, for example, runs the largest bilateral surplus with the United States, while running substantial deficits with some of its Asian neighbors, Japan in particular. Our approach recognizes and incorporates these bilateral asymmetries.

Our earlier work considered the effect of eliminating current account deficits in a world in which factors could seamlessly move between manufacturing and other activities. Although this assumption might apply to the very long run, it probably fails to capture barriers to internal factor mobility that are likely to loom large for some time. Here we pursue the opposite extreme of treating factors as fixed in either manufacturing or nonmanufacturing activity. For comparison purposes, we present our results for the case of perfect factor mobility as well.

In either case we allow adjustment to take the form of changes in the range of goods that countries exchange (the extensive margin) as well as changes in the amounts of each good traded (the intensive margin). But adjustment at the extensive margin may take time. Hence, to capture very short-run effects we consider a case in which both the allocation of labor and the extensive margin are fixed.

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[1]We describe how we created this sample and where our data come from in Section II.

[2]This number is not only very large absolutely, it is also large relative to U.S. GDP. Australia, Greece, and Portugal have larger deficit-to-GDP ratios. Some small countries run current account surpluses that are much larger fractions of their GDP. The Bureau of Economics Analysis reports the U.S. current account deficit in 2006 as $857 billion, 6.1 percent of GDP.

Table 1. GDP and Deficit Measures, 2004

			Deficits		
Country	Code	GDP	Current account	Trade	Mfg
Algeria	alg	85	−11.2	−7.2	11.8
Argentina	arg	153	−3.6	−11.0	9.5
Australia	aul	659	39.2	21.8	57.5
Austria	aut	293	−1.2	−4.4	7.3
Belgium/Luxem	bex	392	−16.6	−20.5	52.6
Brazil	bra	604	−12.5	−26.1	−8.8
Canada	can	992	−22.5	−35.7	22.5
Chile	chl	96	−1.7	−8.1	−2.4
China/HK	chk	2106	−87.2	−54.0	−119.4
Colombia	col	98	0.8	0.8	8.2
Denmark	den	245	−6.3	−11.3	9.3
Egypt	egy	82	−4.0	0.8	1.1
Finland	fin	189	−9.9	−9.6	−17.1
France	fra	2060	4.1	7.4	−3.3
Germany	ger	2740	−105.4	−122.9	−278.3
Greece	gre	264	13.1	13.9	29.2
India	ind	689	−7.8	14.5	−11.9
Indonesia	ino	254	−1.9	−10.1	−25.1
Ireland	ire	183	0.8	−25.5	−68.8
Israel	isr	122	−3.3	0.1	−2.2
Italy	ita	1720	13.4	−4.0	−46.6
Japan	jap	4580	−178.1	−72.4	−385.1
Korea	kor	680	−29.1	−26.3	−146.4
Ma/Phi/Sing	mps	312	−43.2	−45.9	−58.3
Mexico	mex	683	5.8	17.8	20.2
Netherlands	net	608	−55.2	−44.4	8.9
New Zealand	nze	98	6.3	1.1	10.0
Norway	nor	255	−35.1	−34.9	16.0
Pakistan	pak	113	0.7	6.5	−0.9
Peru	per	70	−0.1	−1.6	2.5
Portugal	por	178	12.7	14.3	9.8
Russia	rus	592	−59.4	−69.6	−11.7
South Africa	saf	216	7.2	2.6	1.0
Spain	spa	1040	53.5	44.8	61.7
Sweden	swe	349	−27.9	−27.4	−26.2
Switzerland	swi	360	−57.1	−32.8	−13.4
Thailand	tha	161	−7.1	−6.0	−21.1
Turkey	tur	302	15.2	12.5	18.0
United Kingdom	unk	2150	32.3	74.2	103.5
United States	usa	11700	649.7	667.0	438.4
Venezuela	ven	112	−14.0	−17.3	6.0
Rest of world	row	3025	−53.4	−171.3	341.9

Note: All data are in billions of U.S. dollars. Negative numbers indicate surplus. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

Both this paper and our previous one return to a venerable topic, the potential for a secondary burden of a transfer. A question we can answer is the extent to which the elimination of the giant U.S. current account deficit entails a loss in real resources beyond the loss of the transfer itself. Our model recognizes the importance of nontradability, so that it delivers Keynes' prediction that the elimination of a transfer entails a worsened terms of trade. But as our model also incorporates nontraded goods whose prices decline, the burden of paying more for imports is mostly offset by the benefit of cheaper nontraded goods. With an active extensive margin, the offset is nearly complete. Our numbers thus come down on the side of Ohlin: the elimination of the transfer entails a loss in real absorption of virtually the same magnitude.[3]

This prediction emerges under either extreme assumption about factor mobility. But factor immobility introduces a major additional consideration: The internal redistribution of income implied by global rebalancing. We find that, with resource immobility, eliminating the current account deficit raises the returns to U.S. factors working in manufacturing to those working elsewhere by about 30 percent (with or without adjustment at the extensive margin).

Obstfeld and Rogoff (2005) also employ a static trade model to examine the implications of eliminating current account imbalances. Their focus is on real exchange rates and the terms of trade, rather than real wages and welfare, our interest here. They employ a stylized three-region model. With labor mobility our results are closest to what Obstfeld and Rogoff call a "very gradual" unwinding, or a decade-long adjustment, but labor immobility (with or without an operative extensive margin) connects better with their baseline scenario.[4]

I. A Model of the World

We consider a world of $i=1, \ldots, N$ countries. Country i is endowed with labor L_i.[5] Labor is allocated between two sectors, manufacturing L_i^M and

[3]While our framework can quite handily deal with a multitude of countries, its analytic essence derives from the two-country model of trade and unilateral transfers of Dornbusch, Fischer, and Samuelson (1977).

[4]Corsetti, Martin, and Pesenti (2007) develop a symmetric two-country model in which adjustment can also occur across both the intensive and extensive margins. They examine the long-run consequences of the effects of improving net export deficits of 6.5 percent of GDP in one country to a balanced position. In the version of the model in which all adjustment takes place at the intensive margin, the authors find that closing the external imbalance requires a fall in long-run consumption (of the country undergoing the adjustment) by around 6 percent and a depreciation of the real exchange rate and the terms of trade by 17 and 22 percent respectively. When adjustment can also occur at the extensive margin, there is a much smaller depreciation in the real exchange rate and in the terms of trade, of 1.1 percent and 6.4, respectively. The changes in consumption and welfare under the two versions of the model, however, are similar.

[5]To generalize our analysis to incorporate multiple factors of production one may think of L_i as a vector of factors.

nonmanufacturing L_i^N, with

$$L_i^M + L_i^N = L_i. \tag{1}$$

Throughout we assume that all production is at constant returns to scale and that all markets are perfectly competitive.[6]

Income and Expenditure: Some Accounting

We relate production and trade in manufactures to aggregate income, expenditure, and wages. We have to do some accounting to draw these connections.

We denote country i's gross production of manufactures as Y_i^M, of which a share β_i is value-added. With perfect competition, value added corresponds to factor payments $V_i^M = w_i^M L_i^M$, where w_i^M is the manufacturing wage.

Similarly, w_i^N is the nonmanufacturing wage, so that nonmanufacturing value added is $V_i^N = w_i^N L_i^N$ and GDP is

$$Y_i = V_i^M + V_i^N = w_i^M L_i^M + w_i^N L_i^N.$$

If we define the average wage as

$$w_i = \frac{w_i^M L_i^M + w_i^N L_i^N}{L_i}, \tag{2}$$

then GDP is simply $Y_i = w_i L_i$. Our notation is designed to admit: (i) sectoral labor mobility, in which case L_i^M and L_i^N are endogenous with $w_i^M = w_i^N = w_i$ and (ii) immobile labor, in which case L_i^M and L_i^N are fixed with wages typically differing by sector.

We denote country i's gross absorption of manufactures as X_i^M and its manufacturing deficit as D_i^M. They are connected with Y_i^M via the identity:

$$Y_i^M = X_i^M - D_i^M. \tag{3}$$

Manufactures have two purposes: as inputs into the production of manufactures and to satisfy final demand. We denote the share of manufactures in final demand as α_i so that demand for manufactures in country i is

$$X_i^M = \alpha_i X_i + (1-\gamma)(1-\beta_i) Y_i^M, \tag{4}$$

where X_i is final absorption, equal to GDP Y_i plus the overall trade deficit D_i, and γ is the share of nonmanufactures (hence $1-\gamma$ the share of manufactures) in manufacturing intermediates.[7]

[6] See Eaton, Kortum, and Kramarz (2008) to see how the model could be respecified in terms of monopolistic competition with heterogeneous firms, as in Melitz (2003) and Chaney (forthcoming).

[7] More precisely, the parameter α_i captures both manufactures used in final absorption and manufactures used as intermediates in the production of nonmanufactures. For simplicity, we ignore this feedback from the manufacturing sector to the nonmanufacturing sector. As we discuss below, this feedback appears to be small.

Combining Equations (3) and (4) we obtain

$$\alpha_i(Y_i + D_i) = [\gamma(1-\beta_i) + \beta_i]Y_i^M + D_i^M.$$

Rearranging, we obtain equations for manufacturing production and absorption:

$$Y_i^M = \frac{\alpha_i(w_i L_i + D_i) - D_i^M}{\gamma(1-\beta_i) + \beta_i}, \tag{5}$$

$$X_i^M = \frac{\alpha_i(w_i L_i + D_i) - (1-\gamma)(1-\beta_i)D_i^M}{\gamma(1-\beta_i) + \beta_i}. \tag{6}$$

These equations will allow us to connect world equilibrium in manufactures to various deficits.

International Trade

Manufactures consist of a unit continuum of differentiated goods indexed by j. We denote country i's efficiency making good j as $z_i(j)$. The cost of producing good j in country i is thus $c_i/z_i(j)$, where c_i is the cost of an input bundle in country i. Given the production structure introduced above,

$$c_i = \kappa_i (w_i^M)^{\beta_i} (w_i^N)^{\gamma(1-\beta_i)} p_i^{(1-\gamma)(1-\beta_i)}, \tag{7}$$

where p_i is an index of manufacturing input prices in country i, to be determined below. The term κ_i is a constant that depends on γ, β_i, and the productivity of labor in nonmanufacturing.[8]

We make the standard assumption of "iceberg" trade barriers, implying that to deliver one unit of a manufactured good from country i to country n requires shipping $d_{ni} \geq 1$ units, where we normalize $d_{ii} = 1$. Thus, delivering a unit of good j produced in country i to country n incurs a unit cost:

$$p_{ni}(j) = \frac{c_i d_{ni}}{z_i(j)}.$$

Ricardian Specialization

Here we set up the model assuming that buyers purchase any good from its lowest cost source, so that the extensive margin is active. We turn to what happens if this margin is shut off later in the paper.

As in Eaton and Kortum (2002) country i's efficiency $z_i(j)$ in making good j is the realization of a random variable Z with distribution:

$$F_i(z) = \Pr[Z \leq z] = e^{-T_i z^{-\theta}},$$

[8]If the unit cost function in nonmanufactures is w_i^N/a_i, reflecting productivity a_i, then $\kappa_i = (a_i)^{-\gamma(1-\beta_i)} \beta_i^{-\beta_i} [\gamma(1-\beta_i)]^{-\gamma(1-\beta_i)} [(1-\gamma)(1-\beta_i)]^{-(1-\gamma)(1-\beta_i)}$.

which is drawn independently across i. Here $T_i > 0$ is a parameter that reflects country i's overall efficiency in producing any good and θ is an inverse measure of the dispersion of efficiencies. The implied distribution for p_{ni} (j) is

$$\Pr[P_{ni} \leq p] = \Pr\left[Z \geq \frac{c_i d_{ni}}{p}\right] = 1 - e^{-T_i(c_i d_{ni})^{-\theta} p^{\theta}}.$$

Buyers in destination n will buy each manufacturing good j from the cheapest source at a price:

$$p_n(j) = \min_i \{p_{ni}(j)\}.$$

The distribution G_n (p) of prices paid in country n is

$$G_n(p) = \Pr[P_n \leq p] = 1 - \prod_{i=1}^{N} \Pr[P_{ni} \geq p] = 1 - e^{-\Phi_n p^{\theta}}$$

where:

$$\Phi_n = \sum_{i=1}^{N} T_i (c_i d_{ni})^{-\theta}.$$

The probability $\bar{\pi}_{ni}$ that country i is the cheapest source is its share of this sum:

$$\bar{\pi}_{ni} = \frac{T_i (c_i d_{ni})^{-\theta}}{\Phi_n}. \tag{8}$$

Invoking the law of large numbers, this probability becomes the measure of goods that country n purchases from country i. Thus $\bar{\pi}_{ni}$ is a bilateral trade share measured by numbers of goods. To obtain a trade share measured by expenditures we must specify demand.

Demand for Manufactures

We assume that the individual manufacturing goods, whether used as intermediates or in final demand, combine with constant elasticity $\sigma > 0$. Spending in country n on good j is therefore

$$X_n^M(j) = \left[\frac{p_n(j)}{p_n}\right]^{-(\sigma-1)} X_n^M,$$

where p_n is the manufacturing price index in country n, which appeared previously in expression (7) for the cost of an input bundle. We compute this price index by integrating over the prices of individual goods:

$$p_n = \left[\int_0^{\infty} p^{-(\sigma-1)} dG_n(p)\right]^{-1/(\sigma-1)} = \varphi \Phi_n^{-1/\theta}, \tag{9}$$

where

$$\varphi = \Gamma\left[\frac{\theta - (\sigma - 1)}{\theta}\right]^{-1/\sigma-1}$$

and Γ is the gamma function, requiring $\theta > \sigma - 1$.

We can express bilateral trade shares in expenditure terms mechanically as

$$\pi_{ni} = \frac{X_{ni}^M}{X_n^M} = \frac{\bar{\pi}_{ni}\overline{X}_{ni}^M}{\sum_{k=1}^N \bar{\pi}_{nk}\overline{X}_{nk}^M}, \tag{10}$$

where $\bar{X}_{ni}^M$ is average spending per good in country n on goods purchased from i.

To compute $\bar{X}_{ni}^M$ we need to know the distribution $G_{ni}(p)$ of the prices of goods that country n buys from country i because

$$\overline{X}_{ni}^M = X_n^M \int_0^\infty \left(\frac{p}{p_n}\right)^{-(\sigma-1)} dG_{ni}(p).$$

As shown in Eaton and Kortum (2002), among the goods that n buys from i, the distribution of prices is the same regardless of source, so that $G_{ni}(p) = G_n(p)$. It follows that $\bar{X}_{ni}^M = X_n^M$ and hence Equation (10) becomes

$$\frac{X_{ni}^M}{X_n^M} = \pi_{ni} = \bar{\pi}_{ni} = \frac{T_i(c_i d_{ni})^{-\theta}}{\sum_{k=1}^N T_k(c_k d_{nk})^{-\theta}}. \tag{11}$$

The two measures of the bilateral trade share reduce to the same thing.

Trade Elasticities

How do trade shares and prices respond to changes in input costs around the world? Say that the costs of input bundles in each country k move from c_k to $c_k{}'$. We can represent this change in terms of the ratio $\hat{c}_k = c_k{}'/c_k$.

Extensive Margin Operative

We first consider the case in which a buyer can switch to any new source country that can deliver a good more cheaply. The resulting bilateral trade shares are

$$\pi'_{ni} = \frac{T_i(c'_i d_{ni})^{-\theta}}{\sum_{k=1}^N T_k(c'_k d_{nk})^{-\theta}} = \frac{T_i(c_i d_{ni})^{-\theta}\hat{c}_i^{-\theta}}{\sum_{k=1}^N T_k(c_k d_{nk})^{-\theta}\hat{c}_k^{-\theta}}$$

$$= \frac{\bar{\pi}_{ni}\hat{c}_i^{-\theta}}{\sum_{k=1}^N \bar{\pi}_{nk}\hat{c}_k^{-\theta}}.$$

The parameter determining how changes in costs translate into trade shares is θ, which reflects the extent of heterogeneity in production efficiency. It captures how changes in costs bring about a change in international specialization in production and delivery to various markets, the extensive margin.

We also need to consider how price indices adjust to a change in costs around the world. Starting from Equation (9), with the extensive margin active, the price index resulting from a change in costs is

$$p_n' = \varphi\left[\sum_{i=1}^{N} T_i(c_i' d_{ni})^{-\theta}\right]^{-1/\theta} = \varphi\left[\sum_{i=1}^{N} \Phi_n \bar{\pi}_{ni} \hat{c}_i^{-\theta}\right]^{-1/\theta}$$

$$= p_n\left[\sum_{i=1}^{N} \bar{\pi}_{ni} \hat{c}_i^{-\theta}\right]^{-1/\theta}. \qquad (12)$$

Note that σ is nowhere to be seen.

Extensive Margin Inoperative

Say instead that after input costs change, countries are stuck buying each good from the same source as before, so that adjustment is only in how much is spent on each good, the intensive margin. To see what happens to trade shares, return to Equation (10), this time shutting down the extensive margin by fixing the $\bar{\pi}_{nk}$ s.

The price of any good that country n had bought from country i at price p now costs $p\hat{c}_i$. If country n goes on buying each good from its original source, the resulting bilateral trade shares (with a superscript SR to denote the short run) are

$$(\pi_{ni}^{SR})' = \frac{\bar{\pi}_{ni} \bar{X}_{ni}'^{M}}{\sum_{k=1}^{N} \bar{\pi}_{nk} \bar{X}_{nk}'^{M}}$$

$$= \frac{\bar{\pi}_{ni} X_n^{M'} \int_0^{\infty} \left(p\hat{c}_i / p_n'\right)^{-(\sigma-1)} dG_{ni}(p)}{\sum_{k=1}^{N} \bar{\pi}_{nk} X_n^{M'} \int_0^{\infty} \left(p\hat{c}_k / p_n'\right)^{-(\sigma-1)} dG_{nk}(p)}.$$

Assuming that we started with a situation in which country n bought every good from the lowest cost source, so that $G_{ni}(p) = G_n(p)$, the resulting trade shares simplify to

$$(\pi_{ni}^{SR})' = \frac{\bar{\pi}_{ni} \hat{c}_i^{-(\sigma-1)}}{\sum_{k=1}^{N} \bar{\pi}_{nk} \hat{c}_k^{-(\sigma-1)}}. \qquad (13)$$

The parameter now determining how changes in costs translate into trade shares becomes $\sigma-1$, as in the Armington model. Because $\theta > \sigma-1$, the effective trade elasticity is lower when we shut down the extensive margin.

Parallel to Equation (12) above, we also need an expression for the change in the price index in each country that results from a change in input costs. To derive this expression, recall that we can construct the price index from source-specific blocks:

$$p_n = \left[\sum_{i=1}^{N} \bar{\pi}_{ni} \int_0^{\infty} p^{-(\sigma-1)} dG_{ni}(p)\right]^{-1/(\sigma-1)}.$$

Therefore, in response to a change in costs:

$$(p_n^{SR})' = \left[\sum_{i=1}^{N} \bar{\pi}_{ni} \int_0^{\infty} (p\hat{c}_i)^{-(\sigma-1)} dG_{ni}(p)\right]^{-1/(\sigma-1)}$$

$$= p_n \left[\sum_{i=1}^{N} \bar{\pi}_{ni} \hat{c}_i^{-(\sigma-1)}\right]^{-1/(\sigma-1)}. \quad (14)$$

The elasticity $\sigma - 1$ again replaces θ as the relevant parameter when we shut down the extensive margin. In all other ways, the analysis is exactly parallel.

We will return to this result in our simulations where we interpret $\sigma - 1$ as the short-term trade elasticity. This interpretation is motivated by the dynamic two-country analysis of Ruhl (2005), in which firms choose not to adjust their extensive margin in response to temporary fluctuations in costs. In this case, all adjustment takes place via expenditure per good resulting from changes in prices and incomes.

Equilibrium

The conditions for equilibrium in world manufactures are

$$Y_i^M = \sum_{n=1}^{N} \pi_{ni} X_n^M. \quad (15)$$

This set of equations determines relative wages across countries. To see how, plug in the expressions above for manufacturing production (5) and absorption (6) to obtain

$$\frac{\alpha_i(w_i L_i + D_i) - D_i^M}{\gamma(1-\beta_i) + \beta_i} = \sum_{n=1}^{N} \pi_{ni} \left[\frac{\alpha_n(w_n L_n + D_n) - (1-\gamma)(1-\beta_n) D_n^M}{\gamma(1-\beta_n) + \beta_n}\right]. \quad (16)$$

We obtain an expression for the trade shares by substituting Equation (7) into Equation (11):

$$\pi_{ni} = \frac{T_i \left[\kappa_i (w_i^M)^{\beta_i} (w_i^N)^{\gamma(1-\beta_i)} p_i^{(1-\gamma)(1-\beta_i)} d_{ni}\right]^{-\theta}}{\sum_{k=1}^{N} T_k \left[\kappa_k (w_k^M)^{\beta_k} (w_k^N)^{\gamma(1-\beta_k)} p_k^{(1-\gamma)(1-\beta_k)} d_{nk}\right]^{-\theta}}. \quad (17)$$

From Equations (7) and (9), the price index for manufactures is

$$p_n = \varphi \left(\sum_{i=1}^{N} T_i \left[\kappa_i (w_i^M)^{\beta_i} (w_i^N)^{\gamma(1-\beta_i)} p_i^{(1-\gamma)(1-\beta_i)} d_{ni}\right]^{-\theta}\right)^{-1/\theta}. \quad (18)$$

The size of the nonmanufacturing sector (and hence of the manufacturing sector) is nailed down by

$$V_i^N = w_i^N L_i^N = w_i L_i - \beta_i \frac{\alpha_i (w_i L_i + D_i) - D_i^M}{\gamma(1-\beta_i) + \beta_i}. \tag{19}$$

World equilibrium is a set of wages and price levels w_i^M, w_i^N and p_i and labor allocations L_i^M and L_i^N for each country i that solve Equations (1), (2), and (16)–(19) given parameters including labor endowments and deficits, D_i and D_i^M. To complete the description of equilibrium, we have to take a stand on labor mobility.

We consider the two extreme assumptions regarding internal labor market mobility. In the mobile labor case, which we take as reflecting the long run, the wage equilibrates between sectors, so that $w_i^M = w_i^N = w_i$ with L_i^M and L_i^N determined endogenously. In the immobile labor case, which we take as reflecting the short run, workers are tied to either manufacturing or nonmanufacturing. For this case we take L_i^M and L_i^N as given and solve for $w_i^M$and w_i^N separately.

Our counterfactual experiments calculate the response of all endogenous variables to an exogenous change in deficits around the world.

II. Quantification

Data

We created our sample of 42 countries as follows. We began with the 50 largest as measured by GDP in 2000, and combined the others into a ‘‘country’’ labeled ROW. Incomplete data forced us to move Saudi Arabia, Poland, Iran, the United Arab Emirates, Puerto Rico, and the Czech Republic into ROW as well. Because of peculiarities in the data suggestive of entrepôt trade, which our approach here is ill-equipped to handle, we combined (1) Belgium and Luxembourg (which we pulled out of ROW), (2) China and Hong Kong SAR, and (3) Malaysia, Philippines, and Singapore into single entities. The result is 42 entities, which we refer to as countries, which constitute the entire world.

To solve for the counterfactual, we need data on GDP (for Y_i), manufacturing value added (for V_i^M), gross manufacturing production (for Y_i^M), overall and manufacturing trade deficits (D_i and D_i^M), and bilateral trade flows in manufactures (for X_{ni}^M), including purchases from home X_{ii}^M.

Wherever possible we take data for 2004 with all magnitudes translated into U.S.$ billions. We take GDP Y_i and manufacturing value added V_i^M from the United Nations National Income Accounts Database (2007). We calculate value added in nonmanufacturing as a residual, $V_i^N = Y_i - V_i^M$.

The overall trade deficit in goods and services D_i and current account deficits CA_i, used for our counterfactual experiments below, are from the IMF (2006). We calculate total final spending as $X_i = Y_i + D_i$.[9]

Our handling of production and bilateral trade in manufactures is more involved. Our goal is a matrix of values X_{ni}^M of the manufactures that country n buy from i. We begin with Comtrade data on bilateral trade from the United Nations Statistics Division (2006). We define manufactures as SITC trade codes 5, 6, 7, and 8. We measure trade flows between countries using reports of the importing country. We netted out trade within the three entities containing multiple countries.

Bilateral trade data do not contain an entry for the value of manufactures that country i purchases from local producers, X_{ii}^M. We calculate these diagonal elements of the bilateral trade matrix as follows: (1) For each country i we calculate the share of value added in manufacturing β_i as the ratio of value added in manufacturing to total manufacturing production for the most recent year for which each is available (and not imputed) from the United Nations Industrial Development Organization Industrial Statistics Database (2006).[10] (2) We create a value of Y_i^M for 2004 as $Y_i^M = V_i^M/\beta_i$ using the 2004 value for V_i^M. (3) We calculate $X_{ii}^M = Y_i^M - E_i^M$, where E_i^M is country i's manufacturing exports $E_i^M = \sum_{n \neq i} X_{ni}^M$.

With our bilateral trade matrix, we can calculate the trade deficit in manufactures, D_i^M. Except for the numbers used to calculate β_i all data are for 2004, the most recent year for which we could get complete data.

Calibration

In principle, computing the world equilibrium requires knowing the parameters d_{ni}, κ_i, α_i, β_i, γ, T_i, L_i (L_i^M and L_i^N separately in the case of factor immobility), and θ (or σ in the case with no extensive margin) as well as the actual and counterfactual overall and manufacturing deficits D_i, D_i', D_i^M, and $D_i^{M\prime}$. As explained below, however, because we only consider changes from the current equilibrium, all we need to know about d_{ni}, T_i, and κ_i is contained in the current trade shares π_{ni} but all we need to know about L_i^M and L_i^N is contained in value added V_i^M and V_i^N.

We set $\theta = 8.28$, the central value Eaton and Kortum (2002) report based on bilateral trade and cross-country product-level price data. We also report the implications of shutting down the extensive margin by replacing θ with $\sigma - 1$. There are a wide range of estimates of σ that we might consider.

[9] We have to confront the problem that the data imply nonzero current account and trade balances for the world as a whole. Our procedures cannot explain this discrepancy so we allocated the deficits to countries in proportion to their GDPs. Because we use only importer data to measure bilateral trade in manufactures, world trade in manufactures balances automatically.

[10] For each country i other than ROW a measure of β is available in some year in the interval 1991–2003. Our measure of β for ROW is the simple average of the βs across countries not in ROW.

Bernard Eaton, Jensen, and Kortum (2003) find that $\sigma = 3.79$ (and $\theta = 3.60$) explains the size and productivity of advantage of U.S. plants that export. Ruhl (2005) finds that $\sigma = 2.0$ can reconcile the time-series data regarding the degree of adjustment in trade balances to temporary changes in relative costs. To create a sharper contrast with simulations in which the extensive margin is active, and because our approach of shutting down the extensive margin is inspired by Ruhl (2005), we go with the lower value.

We calculate the share of nonmanufactures in manufacturing inter mediates γ from input-output tables. We do not have enough input-output tables to calculate γ for each country. Instead we calculate $\gamma = 0.43$ from the 1997 input-output use table of the United States, and apply this value for all countries (Organization for Economic Cooperation and Development, 2007).[11]

Using Equations (3) and (4), we calculate α_i as

$$\alpha_i = \frac{V_i^M + \gamma(1 - \beta_i) Y_i^M + D_i^M}{X_i}.$$

Table 2 presents the values of α_i and β_i for our 42 countries, along with data on the share of manufacturing value added in GDP and the share of exports in manufacturing gross production. Of our countries, Algeria has the smallest share of manufacturing value added (at 0.06) and China/Hong Kong (henceforth China) the largest (0.38). Argentina and Egypt have the least outwardly oriented manufacturing sector (10 percent exported), and Malaysia/Philippines/Singapore the most outwardly oriented (94 percent exported). The share of value added in manufacturing β averages about one-third, with India having the lowest value (0.19), and Brazil the highest (0.53). The calculated share of manufactures in final demand ranges from a low of 0.06 in Ireland to a high of 0.78 in China/Hong Kong. In spite of these outliers, the values of α are each typically between 0.25 and 0.50.

Counterfactual Deficits

Our counterfactual is a world in which production and trade in manufactures has adjusted to eliminate all current account imbalances. Not modeling nonmanufacturing trade, we hold nonmanufacturing trade deficits at their 2004 level as a share of world GDP. We thus set for each country i

$$D_i^{M\prime} = D_i^M + CA_i,$$

where CA_i is the 2004 current account surplus. We correspondingly set the new trade deficit at

$$D_i' = D_i + D_i^{M\prime} - D_i^M.$$

[11]As mentioned earlier, we do not take account of the use of manufactures as intermediates in the production of nonmanufactures. According to the 1997 input-output use table for the United States, the share of intermediates in the gross production of nonmanufactures is 8.5 percent.

Table 2. Manufacturing Share of GDP, Export Share of Manufacturing, Share of Manufacturing in Final Demand (Alpha), and Share of Value Added in Manufacturing Gross Output (Beta)

	Shares			
Country	Vmfg/GDP	Exports/Ymfg	Alpha	Beta
Algeria	0.06	0.14	0.26	0.34
Argentina	0.22	0.10	0.52	0.33
Australia	0.11	0.15	0.26	0.39
Austria	0.17	0.57	0.34	0.35
Belgium/Luxembourg	0.15	0.83	0.48	0.27
Brazil	0.22	0.22	0.30	0.53
Canada	0.17	0.47	0.32	0.38
Chile	0.16	0.46	0.26	0.40
China/Hong Kong	0.38	0.23	0.78	0.27
Colombia	0.15	0.19	0.31	0.46
Denmark	0.12	0.68	0.23	0.45
Egypt	0.18	0.10	0.41	0.27
Finland	0.20	0.44	0.32	0.32
France	0.12	0.30	0.31	0.22
Germany	0.20	0.44	0.31	0.31
Greece	0.08	0.15	0.25	0.34
India	0.15	0.12	0.38	0.19
Indonesia	0.28	0.28	0.39	0.39
Ireland	0.24	0.93	0.06	0.34
Israel	0.14	0.72	0.23	0.35
Italy	0.17	0.27	0.35	0.26
Japan	0.21	0.25	0.29	0.36
Korea	0.26	0.64	0.23	0.38
Ma/Phi/Sing	0.27	0.94	0.44	0.29
Mexico	0.16	0.47	0.32	0.35
Netherlands	0.13	0.63	0.31	0.27
New Zealand	0.15	0.18	0.37	0.34
Norway	0.10	0.27	0.31	0.30
Pakistan	0.17	0.18	0.31	0.31
Peru	0.15	0.15	0.30	0.37
Portugal	0.14	0.35	0.32	0.28
Russia	0.16	0.26	0.28	0.38
South Africa	0.17	0.25	0.35	0.29
Spain	0.15	0.24	0.36	0.27
Sweden	0.18	0.58	0.27	0.34
Switzerland	0.19	0.66	0.30	0.39
Thailand	0.35	0.67	0.45	0.40
Turkey	0.20	0.32	0.39	0.38
United Kingdom	0.13	0.30	0.29	0.32
United States	0.13	0.22	0.22	0.48
Venezuela	0.17	0.16	0.34	0.51
Rest of world	0.15	0.45	0.42	0.34

Note: Vmfg is value added in manufacturing, Ymfg is gross production in manufacturing, beta is the share of value added in gross production, and alpha is the share of manufactures in final absorption. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

Table 3 reports the actual and counterfactual trade deficits both overall and in manufactures. Notice that the United States must run a surplus in manufactures of over two hundred billion dollars to balance its current account.

Formulation in Terms of Changes

As for T_i, κ_i, and d_{ni}, direct observations are hard to come by. Instead of attaching numbers to them, and to L_i as well, we reformulate the model to express the equilibrating relationships in terms of aggregates of these parameters that are readily observable. We then solve for the proportional *changes* in wages and prices needed to eliminate current account deficits. We use x' to denote the counterfactual value of variable x and $\hat{x}$ to denote x'/x. We will repeatedly use the fact that factor payments correspond to value added, so that $w_i^{k\prime} L_i^k = \hat{w}_i^k w_i^k L_i^k = \hat{w}_i^k V_i^k$ in each sector $k = M, N$ as well as in the aggregate $w_i{}' L_i = \hat{w}_i w_i L_i = \hat{w}_i Y_i$.

Starting with the equation for the average wage (2), we have

$$\hat{w}_i = s_i^M \hat{w}_i^M + s_i^N \hat{w}_i^N, \tag{20}$$

where the sectoral shares are $s_i^M = V_i^M / Y_i$ and $s_i^N = V_i^N / Y_i$. The goods market-clearing condition (16) becomes

$$\frac{\alpha_i(\hat{w}_i Y_i + D_i') - D_i^{M\prime}}{\gamma(1-\beta_i) + \beta_i} = \sum_{n=1}^{N} \pi'_{ni} \left[\frac{\alpha_n(\hat{w}_n Y_n + D'_n) - (1-\gamma)(1-\beta_n) D_n^{M\prime}}{\gamma(1-\beta_n) + \beta_n} \right]. \tag{21}$$

The trade share Equation (17) becomes

$$\pi'_{ni} = \frac{\pi_{ni} \left(\hat{w}_i^M\right)^{-\theta\beta_i} \left(\hat{w}_i^N\right)^{-\theta\gamma(1-\beta_i)} \left(\hat{p}_i\right)^{-\theta(1-\gamma)(1-\beta_i)}}{\sum_{k=1}^{N} \pi_{nk} \left(\hat{w}_k^M\right)^{-\theta\beta_k} \left(\hat{w}_k^N\right)^{-\theta\gamma(1-\beta_k)} \left(\hat{p}_k\right)^{-\theta(1-\gamma)(1-\beta_k)}}. \tag{22}$$

The price Equation (18) becomes:

$$\hat{p}_n = \left(\sum_{i=1}^{N} \pi_{ni} \left[\left(\hat{w}_i^M\right)^{\beta_i} \left(\hat{w}_i^N\right)^{\gamma(1-\beta_i)} \hat{p}_i^{(1-\gamma)(1-\beta_i)} \right]^{-\theta} \right)^{-1/\theta}. \tag{23}$$

Finally, the sectoral share Equation (19) becomes

$$\hat{V}_i^N = \frac{1}{V_i^N} \left[\hat{w}_i Y_i - \beta_i \frac{\alpha_i(\hat{w}_i Y_i + D_i') - D_i^{M\prime}}{\gamma(1-\beta_i) + \beta_i} \right]. \tag{24}$$

In the case of mobile labor, $\hat{V}_i^N = \hat{L}_i^N$ with

$$\hat{w}_i = \hat{w}_i^M = \hat{w}_i^N. \tag{25}$$

Table 3. Actual and Counterfactual Trade Deficits
(Overall and Manufactures)

	Actual Deficit		Counterfactual Deficit	
Country	Total	Mfg	Total	Mfg
Algeria	−7.24	11.80	4.00	23.03
Argentina	−11.02	9.52	−7.39	13.15
Australia	21.84	57.53	−17.35	18.34
Austria	−4.36	7.25	−3.21	8.41
Belgium/Luxembourg	−20.52	52.58	−3.90	69.19
Brazil	−26.12	−8.84	−13.58	3.71
Canada	−35.70	22.53	−13.23	45.00
Chile	−8.05	−2.43	−6.34	−0.71
China/Hong Kong	−53.97	−119.36	33.22	−32.18
Colombia	0.80	8.21	−0.01	7.40
Denmark	−11.26	9.28	−5.00	15.54
Egypt	0.79	1.12	4.82	5.15
Finland	−9.56	−17.08	0.39	−7.13
France	7.41	−3.27	3.34	−7.34
Germany	−122.90	−278.28	−17.47	−172.85
Greece	13.86	29.18	0.71	16.03
India	14.46	−11.87	22.22	−4.10
Indonesia	−10.13	−25.14	−8.23	−23.25
Ireland	−25.48	−68.85	−26.31	−69.69
Israel	0.13	−2.19	3.45	1.13
Italy	−3.99	−46.57	−17.42	−60.00
Japan	−72.41	−385.08	105.74	−206.94
Korea	−26.29	−146.38	2.79	−117.30
Ma/Phi/Sing	−45.94	−58.26	−2.71	−15.03
Mexico	17.79	20.16	12.00	14.37
Netherlands	−44.38	8.90	10.84	64.12
New Zealand	1.07	9.99	−5.26	3.67
Norway	−34.91	15.96	0.14	51.01
Pakistan	6.52	−0.93	5.85	−1.60
Peru	−1.62	2.47	−1.54	2.55
Portugal	14.34	9.81	1.61	−2.92
Russia	−69.57	−11.67	−10.19	47.71
South Africa	2.64	1.01	−4.52	−6.15
Spain	44.79	61.73	−8.69	8.24
Sweden	−27.42	−26.19	0.53	1.76
Switzerland	−32.76	−13.38	24.30	43.68
Thailand	−5.98	−21.06	1.09	−13.99
Turkey	12.53	18.01	−2.67	2.81
United Kingdom	74.19	103.50	41.87	71.18
United States	666.97	438.40	17.23	−211.34
Venezuela	−17.27	5.97	−3.29	19.95
Rest of world	−171.29	341.91	−117.85	395.34

Note: All data are in billions of U.S. dollars. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

In the case of immobile labor,

$$\hat{V}_i^N = \hat{w}_i^N, \tag{26}$$

with $\hat{L}_i^N = 0$.

In the case of immobile labor with no extensive margin we simply replace θ with $\sigma-1$ in Equations (22) and (23).

The parameters T_i, d_{ni}, κ_i, L_i^M, and L_i^N no longer appear. Instead we have manufacturing value added V_i^M, nonmanufacturing value added V_i^N, and manufacturing trade shares π_{ni}, not the counterfactual values but the actual (factual) ones, X_{ni}^M/X_n^M. We can thus use data on V_n^M, V_n^N, and X_{ni}^M/X_n^M, along with the parameters α_i, β_i, γ, and θ (or σ with no extensive margin) to solve the counterfactual equilibrium changes $\hat{w}_i^M$, $\hat{w}_i^N$, $\hat{V}_i^N$, and $\hat{p}_i$ that arise from moving to counterfactuals deficits D_n' and $D_n^{M\prime}$.

Computation

Simple iterative procedures solve Equations (20)–(24) for changes in wages, employment, and prices, with Equations (26) and (25) employed appropriately for the case at hand. With 42 countries, a good quality laptop running GAUSS can deliver the solutions almost immediately. In this algorithm, world GDP is the numéraire,

$$\sum_{i=1}^{N} \hat{w}_i Y_i = \sum_{i=1}^{N} w_i' L_i = \sum_{i=1}^{N} w_i L_i = Y,$$

hence

$$\sum_{i=1}^{N} \frac{Y_i}{Y} \hat{w}_i = 1.$$

For each of our 42 countries we present the change in a set of outcomes, as the ratio of the counterfactual value to its original value.

In the case of factor immobility, we present the change in manufacturing wage $\hat{w}_i^M$, nonmanufacturing wage $\hat{w}_i^N$, and the change in the overall wage $\hat{w}_i$, using Equation (20). The change in the overall wage corresponds to the change in GDP, because $Y_i' = \hat{w}_i Y_i$. With factor mobility we simply solve for $\hat{w}_i$.

Because we solve for the change in the manufacturing price index $\hat{p}_i$, we can calculate the change in the cost of living as $\hat{p}_i^L = (\hat{p}_i)^{\alpha_i} (\hat{w}_i^N)^{1-\alpha_i}$. We can thus calculate the changes in real wages and real GDP.

Taking into account the static gain or loss of the transfers themselves, we get the change in real absorption in country i as

$$\hat{W}_i = \frac{\hat{w}_i}{\hat{p}_i^L} \frac{1 + D_i'/Y_i'}{1 + D_i/Y_i}.$$

The counterfactual bilateral trade share of country i in n, π_{ni}, can be constructed from the original shares using expression (22). The counterfactual bilateral trade flow of n's imports from i is

$$X'_{ni} = \pi'_{ni}\left[\frac{\alpha_n(Y'_n + D'_n) - (1-\gamma)(1-\beta_n)D_n^{M\prime}}{\gamma(1-\beta_n)+\beta_n}\right].$$

Finally, the change in the share of manufacturing value added in GDP is

$$\frac{\hat{V}_i^M}{\hat{Y}_i} = \frac{1 - s_i^N(\hat{V}_i^N/\hat{Y}_i)}{1 - s_i^N}.$$

We now turn to the results.

III. Results

In discussing the results, we work backwards. Because it is conceptually simplest and relates to our earlier work, we start with the longest run in which both the allocation of labor and the extensive margin can adjust. We then look at a medium run in which labor is locked into its initial sector but the extensive margin still operates. We conclude with the very short run in which neither margin can adjust: labor is immobile and there is no change in the set of goods that countries buy from each other, only how much they buy. Our tables report all results in terms of relative changes, so that if a variable changed from x to x' the table reports $\hat{x} = x'/x$.[12]

Labor Mobility

Table 4 reports the results for the mobile-factor case. With labor mobility, there is a single national wage whose change equals the change in GDP. The changes in wages are reported in the first column. As noted above, they are calculated so that world GDP remains the same.

Note that relative wage changes are quite modest. Taking one of the largest swings, the U.S. wage (and hence GDP) falls relative to Japan's by less than 8 percent. Because most goods are not traded, price indices, reported in the second and third columns, move in the same direction as wages, resulting in changes to real wages (equivalently real GDPs), reported in the fourth column, nearly always a fraction of a percent.

In countries initially in deficit, labor shifts from nonmanufacturing to manufacturing. The change in the manufacturing share is shown in the fifth column. Note that the shifts can be substantial, with the share for the United States rising by almost 23 percent (about 3 percentage points). The manufacturing sector in Japan declines by 8 percent.

The last column of Table 4 shows the change in real absorption. This change is dominated by the primary burden of eliminating the deficit. The United States experiences a 6 percent decline in real absorption but Japan's and Germany's rise by around 4 percent. The change in real absorption

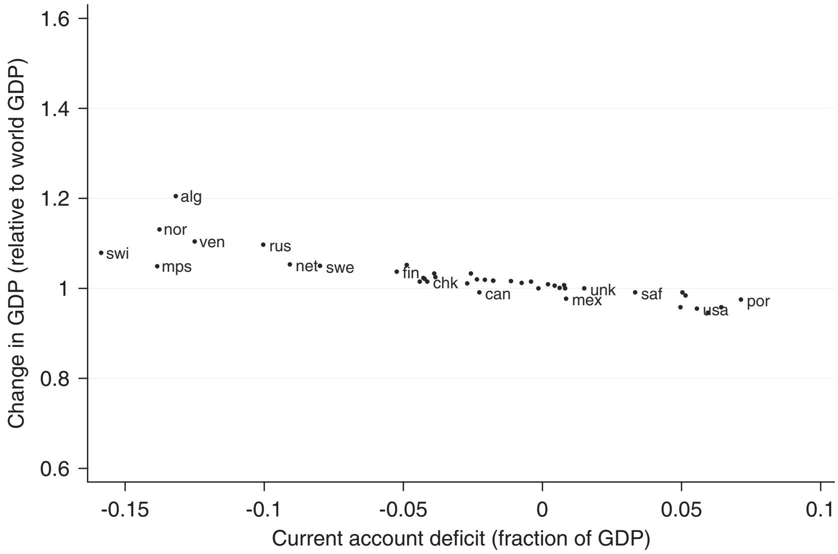
[12]In the text, we refer to a percentage change in x as $100(\hat{x}-1)$ and the percentage change in x_2 relative to x_1 as $100[(\hat{x}_2/\hat{x}_1)-1]$.

Table 4. Changes in Wages (GDP), Manufacturing Price Index, Aggregate Price Index, Real Wages (Real GDP), Manufacturing Share, and Real Absorption
(Factor Mobility)

Country	Wage (GDP)	Price Indices: Mfg	Price Indices: Aggregate	Real Wage (Real GDP)	Mfg Share	Real Absorption
Algeria	1.205	1.055	1.164	1.035	0.469	1.176
Argentina	1.020	1.016	1.018	1.002	0.978	1.029
Australia	0.946	0.969	0.952	0.994	1.235	0.935
Austria	1.015	1.016	1.015	1.000	0.993	1.004
Belgium/Luxembourg	1.021	1.013	1.017	1.004	0.944	1.049
Brazil	1.019	1.015	1.018	1.001	0.952	1.023
Canada	0.991	0.983	0.988	1.003	0.943	1.026
Chile	1.017	1.009	1.015	1.002	0.950	1.023
China/Hong Kong	1.015	1.015	1.015	1.000	0.989	1.042
Colombia	1.000	0.999	0.999	1.000	1.025	0.992
Denmark	1.033	1.022	1.031	1.003	0.901	1.030
Egypt	1.052	1.043	1.048	1.003	0.931	1.049
Finland	1.037	1.027	1.034	1.003	0.905	1.059
France	1.009	1.009	1.009	1.000	1.004	0.998
Germany	1.025	1.018	1.023	1.002	0.930	1.043
Greece	0.958	0.984	0.964	0.993	1.232	0.946
India	1.016	1.015	1.016	1.000	0.982	1.011
Indonesia	1.012	1.012	1.012	1.000	0.988	1.008
Ireland	1.006	1.003	1.006	1.000	1.005	0.996
Israel	1.011	1.008	1.010	1.001	0.916	1.028
Italy	1.007	1.010	1.008	0.999	1.013	0.991
Japan	1.033	1.027	1.031	1.002	0.920	1.040
Korea	1.023	1.015	1.021	1.002	0.915	1.046
Ma/Phi/Sing	1.049	1.008	1.031	1.018	0.860	1.184
Mexico	0.977	0.980	0.978	0.999	1.018	0.991
Netherlands	1.053	1.020	1.043	1.010	0.793	1.108
New Zealand	0.958	0.973	0.963	0.994	1.139	0.929
Norway	1.131	1.063	1.110	1.019	0.651	1.182
Pakistan	1.001	1.003	1.002	0.999	1.012	0.994
Peru	1.000	1.000	1.000	1.000	0.997	1.001
Portugal	0.975	0.991	0.980	0.995	1.168	0.929
Russia	1.097	1.066	1.088	1.008	0.756	1.124
South Africa	0.991	0.997	0.993	0.998	1.063	0.965
Spain	0.984	0.995	0.988	0.996	1.104	0.946
Sweden	1.050	1.030	1.044	1.005	0.818	1.092
Switzerland	1.079	1.027	1.063	1.015	0.667	1.186
Thailand	1.015	1.014	1.015	1.000	0.955	1.046
Turkey	0.991	1.002	0.996	0.996	1.089	0.948
United Kingdom	1.000	1.005	1.001	0.998	1.043	0.984
United States	0.955	0.973	0.959	0.996	1.228	0.944
Venezuela	1.104	1.052	1.086	1.017	0.725	1.170
Rest of world	1.017	1.015	1.016	1.001	0.972	1.020

Note: Simulation results are expressed as a ratio of the counterfactual to the actual value. Simulation based on $\theta = 8.28$. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

Figure 1. Change in GDP, Mobile Labor



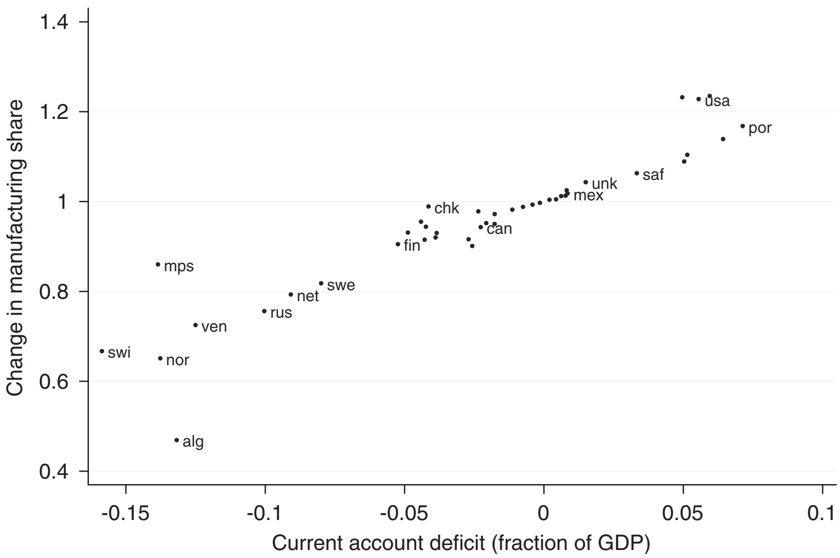
corresponds almost exactly to the change in the transfers involved in eliminating current account deficits. Quantitatively, then, Ohlin was right. There is no discernible secondary burden to eliminating the transfer.

To what extent could we have predicted the changes in wages (and GDPs) from the size of the current account surplus that had to be eliminated? Figure 1 plots the change in the wage reported in the first column of Table 4 against the initial current account deficit as a share of GDP (with country codes as listed in Table 1). Note that there is a definite negative relationship. Mexico and Canada are a bit below other countries with similar deficits, reflecting their proximity to the United States whose relative GDP has declined substantially. There is also a systematic positive relationship between the initial deficit and the change in the size of the manufacturing sector. Figure 2 plots the change in the size of the manufacturing sector (column 5 of Table 4) against the initial current account as a share of GDP. These results closely match those in Dekle, Eaton, and Kortum (2007).

Labor Immobility

Behind the mild price effects of eliminating the deficits just reported are big movements in labor across sectors. What if instead a worker is stuck in the sector where she is initially employed? The first two columns of Table 5 report the changes in relative wages that our model says are needed for manufacturing to balance current accounts, the results for $\hat{w}_i^M$ and $\hat{w}_i^N$, respectively. Again, these changes leave world GDP unchanged. The third column indicates what happens to each country's GDP.

Figure 2. Change in Manufacturing Share, Mobile Labor



Except for Canada, the GDP changes are always in the same direction as in the case of mobile labor, but the magnitudes of the changes are much larger. The United States shrinks relative to Japan by 22 percent (as opposed to 8 percent in the previous case). Figure 3 plots the change in GDP against the initial current account deficit as a share of GDP, using the same scale as Figure 1. Note that the relationship is again negative and about twice as steep as in the case of labor mobility. Hence eliminating countries' ability to reallocate resources requires substantially more adjustment in relative GDPs.

Nearly as systematic is the tendency of the wage in manufacturing relative to nonmanufacturing to rise in countries initially in deficit with the opposite in surplus countries. In the United States, the relative wage in manufacturing rises by 29 percent. The change for Australia, another large deficit country, is nearly as large. In Japan and Germany, the largest surplus countries, the relative wage of manufacturing workers declines by around 10 percent. Looking across countries, changes in nonmanufacturing wages contribute much more to changes in relative GDP. Figure 4 plots the change in the manufacturing share against the initial current account deficit as a share of GDP. Note the systematically positive relationship.

Because of the pervasiveness of nontradedness, both the price index of manufactures (reported in the fourth column of Table 5) and the overall price index (reported in the fourth column of Table 6) move in line with relative GDP. As a consequence, changes in real GDP (reported in the third column of Table 6) are much smaller than the changes in relative GDP. Although the secondary burden of eliminating current account deficits is about twice what it was with labor mobility, it remains a tiny percentage of the initial deficit.

Table 5. Changes in Wages, GDP, and Manufacturing Prices
(Factor Mobility)

Country	Wages: Mfg	Wages: Non-Mfg	GDP	Mfg Price Index
Algeria	0.951	1.402	1.378	1.059
Argentina	1.027	1.055	1.049	1.036
Australia	1.064	0.855	0.877	0.995
Austria	1.032	1.041	1.039	1.036
Belgium/Luxembourg	1.006	1.068	1.059	1.032
Brazil	1.019	1.083	1.069	1.033
Canada	0.977	1.043	1.032	1.003
Chile	1.011	1.073	1.063	1.028
China/Hong Kong	1.024	1.043	1.036	1.034
Colombia	1.030	1.006	1.010	1.021
Denmark	1.012	1.117	1.105	1.039
Egypt	1.023	1.113	1.096	1.062
Finland	0.992	1.128	1.101	1.045
France	1.033	1.028	1.028	1.030
Germany	0.997	1.096	1.076	1.037
Greece	1.081	0.888	0.904	1.010
India	1.022	1.043	1.040	1.035
Indonesia	1.025	1.042	1.037	1.032
Ireland	1.034	1.015	1.019	1.024
Israel	0.979	1.082	1.068	1.026
Italy	1.037	1.020	1.023	1.030
Japan	1.003	1.119	1.095	1.046
Korea	0.981	1.130	1.092	1.034
Ma/Phi/Sing	0.956	1.174	1.114	1.029
Mexico	1.002	0.982	0.985	1.001
Netherlands	0.936	1.181	1.150	1.037
New Zealand	1.048	0.909	0.930	0.997
Norway	0.943	1.322	1.283	1.071
Pakistan	1.028	1.012	1.015	1.023
Peru	1.018	1.022	1.022	1.020
Portugal	1.103	0.915	0.941	1.014
Russia	0.983	1.300	1.250	1.077
South Africa	1.052	0.975	0.988	1.018
Spain	1.070	0.954	0.971	1.017
Sweden	0.953	1.210	1.164	1.046
Switzerland	0.909	1.368	1.282	1.041
Thailand	1.005	1.080	1.054	1.034
Turkey	1.060	0.953	0.975	1.024
United Kingdom	1.044	0.997	1.003	1.026
United States	1.065	0.827	0.858	0.998
Venezuela	1.017	1.316	1.267	1.061
Rest of world	1.022	1.053	1.048	1.034

Note: Simulation results are expressed as a ratio of the counterfactual to the actual value. Simulation based on $\theta = 8.28$. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

Figure 3. Change in GDP, Immobile Labor

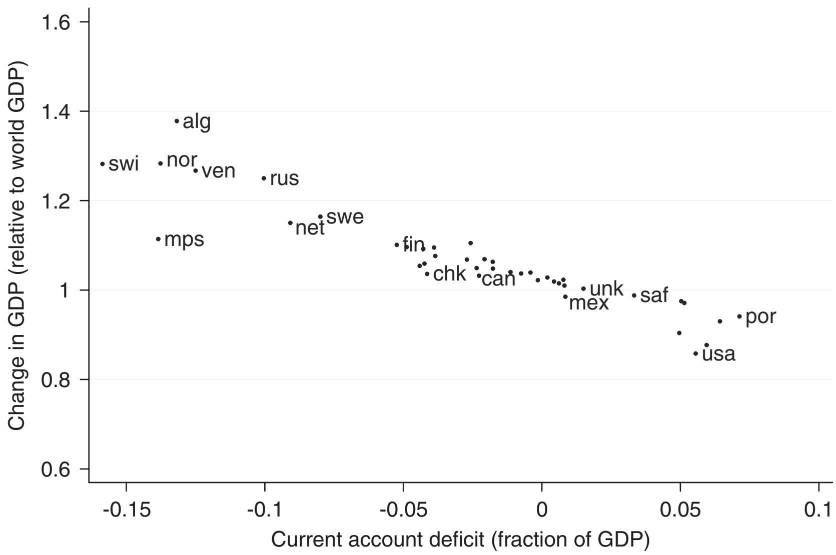
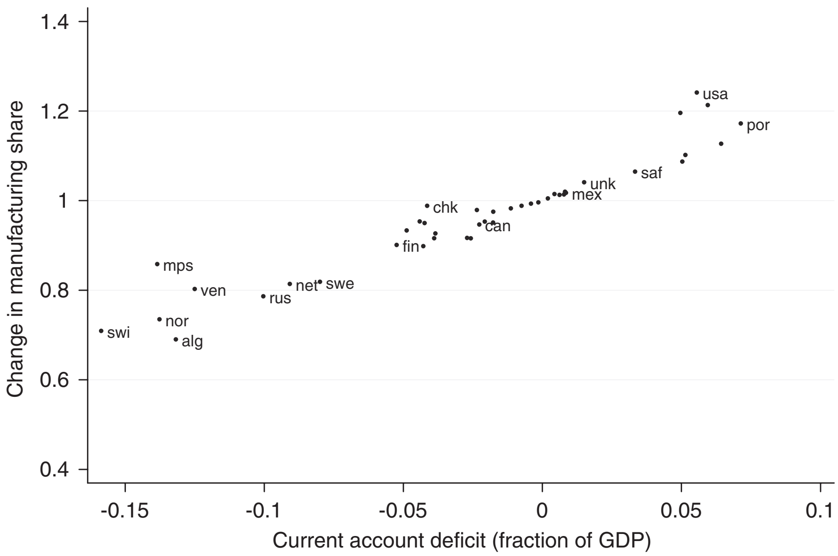


Figure 4. Change in Manufacturing Share, Immobile Labor



Although aggregate changes are small, the redistributional effects are substantial. Column 1 of Table 6 shows real gains to labor in the manufacturing sector in countries that are initially in deficit. In the United States, the real wage in manufacturing rises by 24 percent but declines by 4 percent outside manufacturing. In Japan, the real manufacturing wage declines by 9 percent with a 2 percent gain in nonmanufacturing. In every country the real wage moves in opposite directions in the two sectors.

Table 6. Changes in Real Wages, Real GDP, Aggregate Price Index, and Real Absorption
(Factor Immobility)

Country	Real Wages: Mfg	Real Wages: Non-Mfg	Real GDP	Aggregate Price Index	Real Absorption
Algeria	0.730	1.076	1.057	1.303	1.195
Argentina	0.983	1.010	1.004	1.045	1.032
Australia	1.197	0.961	0.987	0.889	0.926
Austria	0.993	1.002	1.000	1.039	1.005
Belgium/Luxembourg	0.958	1.017	1.008	1.051	1.054
Brazil	0.954	1.014	1.001	1.068	1.024
Canada	0.948	1.013	1.002	1.030	1.026
Chile	0.953	1.011	1.002	1.061	1.026
China/Hong Kong	0.988	1.007	1.000	1.036	1.042
Colombia	1.019	0.995	0.999	1.010	0.991
Denmark	0.921	1.016	1.005	1.099	1.034
Egypt	0.937	1.019	1.004	1.092	1.048
Finland	0.901	1.025	0.999	1.101	1.055
France	1.004	0.999	1.000	1.028	0.998
Germany	0.925	1.017	0.998	1.078	1.039
Greece	1.179	0.969	0.986	0.917	0.939
India	0.983	1.003	1.000	1.040	1.010
Indonesia	0.987	1.004	0.999	1.038	1.008
Ireland	1.018	0.999	1.004	1.015	1.002
Israel	0.916	1.012	0.999	1.069	1.024
Italy	1.013	0.997	1.000	1.024	0.992
Japan	0.913	1.020	0.997	1.098	1.035
Korea	0.886	1.020	0.986	1.107	1.030
Ma/Phi/Sing	0.863	1.061	1.006	1.107	1.171
Mexico	1.015	0.994	0.997	0.988	0.989
Netherlands	0.826	1.042	1.014	1.134	1.111
New Zealand	1.114	0.966	0.988	0.941	0.922
Norway	0.761	1.067	1.036	1.239	1.201
Pakistan	1.013	0.997	0.999	1.015	0.993
Peru	0.996	1.001	1.000	1.022	1.002
Portugal	1.166	0.968	0.995	0.946	0.930
Russia	0.797	1.054	1.013	1.234	1.133
South Africa	1.063	0.985	0.999	0.990	0.966
Spain	1.096	0.977	0.995	0.976	0.945
Sweden	0.819	1.040	1.001	1.164	1.087
Switzerland	0.721	1.085	1.018	1.260	1.178
Thailand	0.949	1.020	0.995	1.059	1.040
Turkey	1.082	0.973	0.995	0.980	0.947
United Kingdom	1.038	0.992	0.998	1.005	0.983
United States	1.237	0.960	0.996	0.861	0.944
Venezuela	0.831	1.076	1.036	1.223	1.196
Rest of world	0.978	1.007	1.003	1.045	1.024

Note: Simulation results are expressed as a ratio of the counterfactual to the actual value. Simulation based on $\theta = 8.28$. MA/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

No Extensive Margin

Sticking with a situation of labor immobility, we now take the further step of eliminating the extensive margin of adjustment. We interpret this case as applying to the very short run. Implementing this case amounts to replacing θ with $\sigma-1$ in our solution algorithm described above. As mentioned, we follow Ruhl (2005) in setting $\sigma=2.0$. There are thus two interpretations of what we are doing in this case. One is that the parameter $\theta=8.28$ is as above, but with no adjustment on the extensive margin, the parameter $\sigma=2$ becomes the relevant one governing adjustment. Another interpretation is that we are simply repeating the immobile labor case, now using the much lower value of $\theta=1$.

The results are shown in Tables 7 and 8. Focusing on relative GDP changes (in column 3 of Table 7), we see that they are magnified considerably when the extensive margin is inoperable. U.S. GDP falls by about 30 percent, but Japan's rises by 26 percent relative to the world. Figure 5 plots the change in GDP against the initial deficit as a share of GDP, again using the same scale as Figure 1. Note that the relationship has become twice as steep again as that portrayed in Figure 3. Note also that U.S. neighbors Canada and Mexico have fallen further below the rest.

Table 7. Changes in Wages, GDP, and Manufacturing Prices
(Factor Immobility, No Adjustment on Extensive Margin)

Country	Wages: Mfg	Wages: Non-Mfg	GDP	Mfg Price Index
Algeria	1.382	1.561	1.551	1.177
Argentina	1.102	1.114	1.112	1.087
Australia	0.865	0.724	0.740	0.899
Austria	1.094	1.097	1.096	1.093
Belgium/Luxembourg	1.076	1.114	1.108	1.072
Brazil	1.074	1.139	1.125	1.075
Canada	0.876	0.957	0.943	0.911
Chile	1.062	1.125	1.115	1.050
China/Hong Kong	1.068	1.090	1.082	1.082
Colombia	1.030	1.008	1.011	1.014
Denmark	1.117	1.199	1.190	1.108
Egypt	1.226	1.311	1.295	1.226
Finland	1.133	1.310	1.274	1.152
France	1.064	1.059	1.060	1.060
Germany	1.085	1.215	1.188	1.105
Greece	0.935	0.807	0.817	0.970
India	1.071	1.096	1.093	1.083
Indonesia	1.073	1.102	1.094	1.085
Ireland	1.042	1.030	1.033	1.027
Israel	0.973	1.076	1.061	1.038
Italy	1.060	1.045	1.048	1.061

Table 7 *(concluded)*

Country	Wages: Mfg	Wages: Non-Mfg	GDP	Mfg Price Index
Japan	1.135	1.296	1.262	1.169
Korea	1.039	1.250	1.196	1.087
Ma/Phi/Sing	1.074	1.336	1.264	1.053
Mexico	0.861	0.852	0.853	0.903
Netherlands	1.081	1.309	1.280	1.093
New Zealand	0.884	0.798	0.811	0.908
Norway	1.336	1.573	1.549	1.250
Pakistan	1.007	0.988	0.991	1.013
Peru	1.000	1.008	1.007	1.006
Portugal	1.004	0.826	0.851	0.977
Russia	1.333	1.634	1.587	1.315
South Africa	1.007	0.930	0.943	0.996
Spain	0.995	0.890	0.905	0.992
Sweden	1.104	1.397	1.346	1.144
Switzerland	1.086	1.555	1.468	1.117
Thailand	1.050	1.141	1.110	1.084
Turkey	1.023	0.922	0.943	1.027
United Kingdom	1.039	0.994	1.000	1.039
United States	0.889	0.673	0.701	0.891
Venezuela	1.352	1.531	1.502	1.213
Rest of world	1.078	1.090	1.088	1.083

Note: Simulation results are expressed as a ratio of the counterfactual to the actual value. Simulation based on $\sigma = 2$. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

As in the previous case, most of the GDP adjustment occurs through the nonmanufacturing wage. Figure 6 plots the change in the manufacturing share against the initial current account deficit. It looks very similar to Figure 4.

Again, prices tend to move in line with relative GDP, so that changes in real GDP are small. They are, nonetheless, substantially larger than in the previous two cases. Note that U.S. real GDP falls by about 2 percent, about a third of the initial deficit. Hence with a very low response of trade shares to costs, a nontrivial secondary burden appears.

Qualitatively the consequences of adjustment for real wages are much as in the previous case, with the manufacturing real wage rising in deficit countries and falling in surplus countries. For the United States, at least, the burden of the inability to adjust at the extensive margin is born by workers outside manufacturing. The increase in the manufacturing real wage is as in the previous case, but the decline in the nonmanufacturing wage is greater.

Table 8. Changes in Real Wages, Real GDP, Aggregate Price Index, and Real Absorption
(Factor Immobility, No Adjustment on Extensive Margin)

Country	Real Wages		Real GDP	Aggregate Price Index	Real Absorption
	Mfg	Non-Mfg			
Algeria	0.953	1.077	1.070	1.450	1.205
Argentina	1.002	1.013	1.011	1.100	1.042
Australia	1.129	0.946	0.965	0.766	0.901
Austria	0.999	1.001	1.001	1.095	1.006
Belgium/Luxembourg	0.984	1.019	1.014	1.094	1.060
Brazil	0.959	1.017	1.005	1.120	1.029
Canada	0.930	1.016	1.001	0.942	1.024
Chile	0.961	1.018	1.009	1.105	1.036
China/Hong Kong	0.986	1.006	0.998	1.084	1.039
Colombia	1.020	0.998	1.002	1.010	0.993
Denmark	0.949	1.018	1.010	1.178	1.040
Egypt	0.961	1.027	1.015	1.276	1.051
Finland	0.901	1.042	1.013	1.258	1.069
France	1.004	1.000	1.000	1.059	0.998
Germany	0.920	1.030	1.008	1.179	1.049
Greece	1.107	0.955	0.968	0.844	0.922
India	0.982	1.005	1.001	1.091	1.010
Indonesia	0.979	1.006	0.999	1.096	1.009
Ireland	1.012	1.000	1.003	1.030	1.003
Israel	0.912	1.008	0.995	1.067	1.021
Italy	1.009	0.995	0.997	1.051	0.990
Japan	0.902	1.030	1.003	1.258	1.038
Korea	0.857	1.032	0.987	1.211	1.031
Ma/Phi/Sing	0.893	1.111	1.052	1.202	1.225
Mexico	0.992	0.982	0.983	0.868	0.978
Netherlands	0.874	1.058	1.035	1.237	1.132
New Zealand	1.057	0.953	0.968	0.837	0.895
Norway	0.912	1.074	1.057	1.465	1.225
Pakistan	1.011	0.992	0.995	0.995	0.990
Peru	0.992	1.001	0.999	1.008	1.001
Portugal	1.152	0.948	0.976	0.872	0.913
Russia	0.867	1.062	1.032	1.538	1.156
South Africa	1.058	0.976	0.990	0.952	0.957
Spain	1.075	0.961	0.978	0.925	0.929
Sweden	0.833	1.055	1.016	1.325	1.104
Switzerland	0.771	1.104	1.042	1.408	1.200
Thailand	0.942	1.024	0.995	1.115	1.040
Turkey	1.064	0.959	0.980	0.962	0.932
United Kingdom	1.032	0.987	0.993	1.006	0.979
United States	1.243	0.940	0.980	0.716	0.929
Venezuela	0.956	1.083	1.062	1.414	1.231
Rest of world	0.991	1.003	1.001	1.087	1.023

Note: Simulation results are expressed as a ratio of the counterfactual to the actual value. Simulation based on $\sigma = 2$. Ma/Phi/Sing is a combination of Malaysia, the Philippines, and Singapore.

Figure 5. Change in GDP, Immobile Sourcing

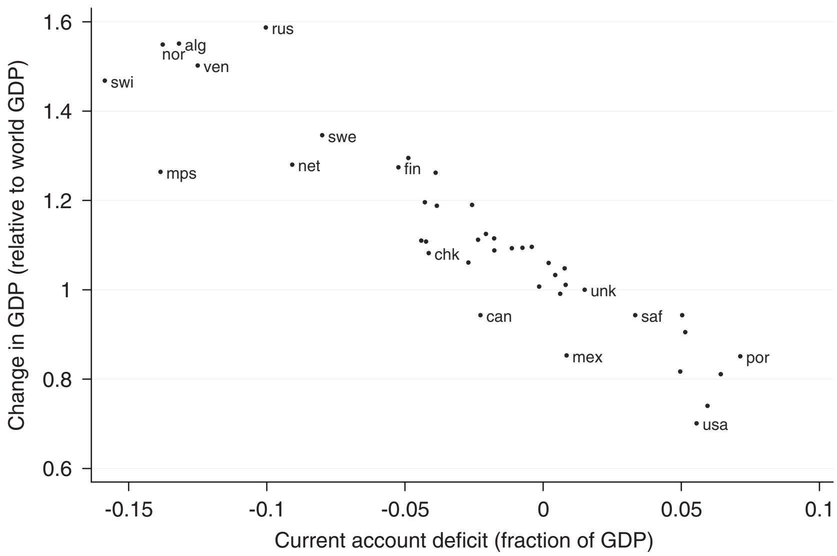
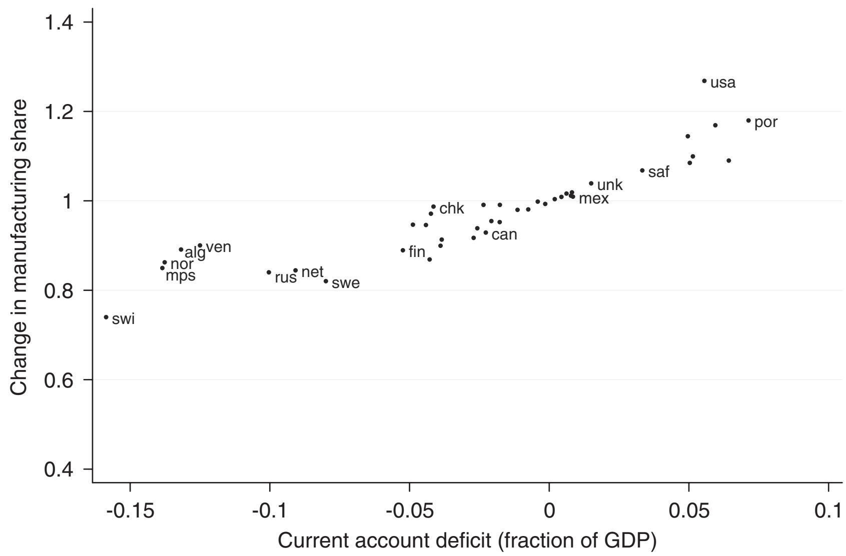


Figure 6. Change in Manufacturing Share, Immobile Sourcing



IV. Conclusion

We have revisited the question of the secondary burden of transfers using a 42-country gravity model of international production and trade in manufactures. Our motivation is to assess the implications for relative wages, relative GDPs, real wages, and real absorption in the major countries of the world should the current transfers implied by existing current account deficits come to a halt. How much relative GDPs need to change depends on flexibility of two forms, factor mobility between manufacturing and nonmanufacturing, and the ability of trade to adjust at the extensive margin. With perfect mobility and an active extensive margin, the GDP of the United States (running the largest deficit) must fall about 8 percent relative to that of Japan (running the largest surplus). Without mobility, however, the decline is 22 percent. If there is no adjustment in supplier sourcing (the extensive margin) either, the decline is 44 percent.

Because of the pervasiveness of nontraded goods, however, prices move largely in sync with relative GDPs so that aggregate real changes are much more muted. Regardless of the degree of labor mobility, the decline in U.S. real GDP is only 0.4 percent if the extensive margin is operative. Without an extensive margin, the drop rises to 2 percent of GDP. So only with extreme inflexibility does a secondary burden of eliminating the transfer inherent in the U.S. current account deficit show up.

Although the overall real effects are small, with factor immobility redistributional effects are substantial. Regardless of whether the extensive margin is operative, eliminating current account deficits leads to a rise in the U.S. wage in manufactures relative to nonmanufactures of around 30 percent, reflecting a 24 percent real increase for manufacturing workers and a decline of around 5 percent for nonmanufacturing workers. In the long run in which labor is mobile, this wage difference induces an increase in the manufacturing share of employment of 23 percent.

REFERENCES

Alvarez, Fernando, and Robert E. Lucas, 2007, "General Equilibrium Analysis of the Eaton-Kortum Model of International Trade," *Journal of Monetary Economics*, Vol. 54, No. 6, pp. 726–68.

Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum, 2003, "Plants and Productivity in International Trade," *American Economic Review*, Vol. 93, No. 4, pp. 1268–90.

Chaney, Thomas, forthcoming, "Distorted Gravity: Heterogeneous Firms, Market Structure, and the Geography of International Trade," *American Economic Review*.

Corsetti, Giancarlo, Philippe Martin, and Paolo Pesenti, 2007, "Varieties and the Transfer Problem: The Extensive Margin of Current Account Adjustment" (unpublished; Federal Reserve Bank of New York).

Dekle, Robert, Jonathan Eaton, and Samuel Kortum, 2007, "Unbalanced Trade," *American Economic Review, Papers and Proceedings*, Vol. 97, No. 3, pp. 351–5.

Dornbusch, Rudiger, Stanley Fisher, and Paul Samuelson, 1977, "Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods," *American Economic Review*, Vol. 67, No. 4, pp. 823–9.

Eaton, Jonathan, and Samuel Kortum, 2002, "Technology, Geography, and Trade," *Econometrica*, Vol. 70, No. 5, pp. 1741–80.

Eaton, Jonathan, Samuel Kortum, and Francis Kramarz, 2008, "An Anatomy of International Trade: Evidence from French Firms" (unpublished; CREST-INSEE, New York University, University of Chicago).

International Monetary Fund (IMF), 2006, *International Financial Statistics Yearbook* (Washington, IMF).

Melitz, Marc, 2003, "The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations," *Econometrica*, Vol. 71, No. 6, pp. 1625–95.

Obstfeld, Maurice, and Kenneth Rogoff, 2005, "Global Current Account Imbalances and Exchange Rate Adjustments," *Brookings Papers on Economic Activity*, Vol. 25, No. 1, pp. 67–146.

Organization for Economic Cooperation and Development, 2007, "Structural Analysis Database," Available on the Internet: www.oecd.org/document/15/0,2340,en_2649_201185_1895503_1_1_1_1,00.html.

Ruhl, Kim, 2005, "The Elasticity Puzzle in International Economics" (unpublished; University of Texas at Austin).

United Nations Industrial Development Organization, 2006 Industrial Statistics Database Available on the Internet: www.unido.org/index.php.

United Nations Statistics Division, 2006 United Nations Commodity Trade Database Available on the Internet: http://comtrade.un.org/.

———, 2007 National Accounts Available on the Internet: http://unstats.un.org/unsd/snaama.