Unbalanced Trade

By ROBERT DEKLE, JONATHAN EATON, AND SAMUEL KORTUM*

We incorporate imbalances into a quantitative model of bilateral trade, calculating how relative factor costs and welfare would change if current accounts were all balanced. While our exercise does not point to what policy would eliminate imbalances, it does suggest the magnitude of the long-run adjustments that such a policy would entail.

We divide the world, as of 2004, into 40 "countries."[1] Table 1 lists current accounts for each country, both in US dollars (billions) and as a share of GDP.[2] The United States has the greatest current account imbalance, running a deficit of $664 billion or nearly 6 percent of its GDP. The three largest surplus countries (Japan, Germany, and China, in that order) collectively run a surplus of $362 billion. While our quantitative analysis models the interaction of all 40 countries, we concentrate on these four due to space constraints. See the NBER Working Paper for a full set of results.

Table 2 reports data on trade in manufactures for our four countries. The biggest exporter is China while the biggest importer is the United States. Unilateral trade balances in manufactures mirror the current account. The US trade deficit with China is one-third of its total deficit in manufactures, while China's surplus with the United States is larger than its overall trade surplus in manufactures. China is running a manufacturing trade deficit with all other countries, except for the United States. Its largest deficit is with Japan. Our approach acknowledges these asymmetric patterns of bilateral trade.

Trade imbalances have been the domain of international macroeconomics, with recent work examining the roots of trade deficits using dynamic analysis. Nevertheless, changes in these deficits will entail resource reallocations across countries, the domain of static trade models.[3]

Here, we build on a recent literature that integrates the gravity equation exhibited by bilateral trade flows into general equilibrium. We depart, however, from a central feature of the gravity specification, which uses sundry geographical,

†*Discussants:* Chang-Tai Hsieh, University of California, Berkeley; Gita Gopinath, Harvard University.

* Dekle: University of Southern California and Federal Reserve Bank of New York, 33 Liberty Street, New York, NY 10045 (e-mail: dekle@usc.edu); Eaton: New York University, 19 West 4th Street, New York, NY 10003, and National Bureau of Economic Research (e-mail: jonathan.eaton@nyu.edu); Kortum: University of Chicago, 1126 East 59th Street Chicago, IL 60637, and NBER (e-mail: kortum@uchicago.edu). Chang-Tai Hsieh provided insightful comments. We thank Deirdre Daly for exceptional research assistance. We also benefited from discussions with Fernando Alvarez and Lars Hansen. Eaton and Kortum gratefully acknowledge the support of the National Science Foundation. Any opinions expressed are those of the authors and not necessarily those of the Federal Reserve System, the NBER, or the NSF.

[1] We take the 50 largest countries, measured by GDP in 2000, with all others grouped into "rest of world" (ROW). Poor data forced us to move Saudi Arabia, Poland, Iran, the United Arab Emirates, Puerto Rico, and the Czech Republic into ROW. To mitigate the effect of entrepôt trade, which our approach can't handle, we combined (1) Belgium, Luxembourg (which we pulled out of ROW), and the Netherlands, (2) Indonesia, Malaysia, Singapore, and Thailand, and (3) China and Hong Kong into single entities.

[2] Data for GDP are from the World Bank (2006), for the balance of payments are from the International Monetary Fund (IMF) (2006), and for trade in manufactures (from import data) are from the United Nations Statistics Division (2006). Manufacturing consists of chemicals, materials, machinery and transport equipment, and miscellaneous manufacturing. Because of statistical error the World's current account and trade balances are not zero. We attribute one-fortieth of each discrepancy to each country.

[3] Maurice Obstfeld and Kenneth S. Rogoff (2005) also employ a static trade model to examine the implications of eliminating current account imbalances. While theirs is a stylized three-region model, ours incorporates the pattern of bilateral trade among 40 countries. Focusing on real exchange rates and terms of trade, they ignore real wages and welfare. Our numerical results are closest to what they call a "very gradual" unwinding, which they interpret as a 10 to 12 year adjustment. Kim Ruhl (2005) develops an explicit dynamic model to reconcile the observed short-run and long-run responsiveness of trade flows to changes in policy.

TABLE 1—CURRENT ACCOUNT IMBALANCES (2004)

		CA. surplus	
	Country	(US$ bill.)	(% GDP)
Alg	Algeria	12.4	14.6
Arg	Argentina	4.7	3.1
Aul	Australia	−38.8	−6.1
Aut	Austria	2.0	0.7
BeN	Bel/Lx/Ne	73.0	7.6
Bra	Brazil	13.0	2.2
Can	Canada	22.4	2.3
Chl	Chile	2.8	3.0
ChH	China/HK	85.6	4.1
Col	Colombia	0.3	0.3
Den	Denmark	7.2	3.0
Egy	Egypt	5.2	6.6
Fin	Finland	11.0	5.9
Fra	France	−5.6	−0.3
Ger	Germany	103.0	3.8
Gre	Greece	−12.2	−6.0
Ind	India	8.1	1.2
IMT	Indo/Ml/Sg/Th	54.6	8.5
Ire	Ireland	0.2	0.1
Isr	Israel	4.4	3.8
Ita	Italy	−14.5	−0.9
Jap	Japan	173.3	3.7
Kor	Korea	29.4	4.3
Mex	Mexico	−5.4	−0.8
NZ	New Zealand	−5.2	−5.3
Nor	Norway	36.0	14.4
Pak	Pakistan	0.4	0.5
Per	Peru	1.2	1.8
Phi	Philippines	2.9	3.2
Por	Portugal	−11.7	−7.0
Rus	Russian Fed.	59.8	10.1
SA	South Africa	−6.2	−2.9
Spa	Spain	−53.6	−5.2
Swe	Sweden	28.7	8.3
Swi	Switzerland	57.8	16.2
Tur	Turkey	−14.3	−4.7
UK	United Kingdom	−33.9	−1.6
USA	United States	−664.0	−5.7
Ven	Venezuela	15.1	13.7
ROW	ROW	50.7	1.7

historical, linguistic, and political variables as indicators of bilateral resistance to trade. Instead, we treat bilateral resistance for each country pair as a parameter which we identify, in combination with other parameters of the model, directly from 2004 bilateral trade data.[4]

[4] Eaton and Kortum (2002, equation (15)) demonstrate how a country's gains from trade can be inferred without imposing structure on trade costs. Andrew B. Bernard et al. (2003) show that the bilateral trade matrix is a sufficient statistic for a set of parameters, which includes the matrix of trade costs, in simulating a model of individual producers in international competition. Recent work by Michael E. Waugh (2007) pursues a related approach for assessing the contribution of trade to development.

TABLE 2—TRADE IN MANUFACTURES (2004)

	Gross trade		Trade	Bilateral surplus	
Country	Exports	Imports	balance	with US	with China
China/ Hong Kong	816.8	695.0	121.8	166.6	
Germany	750.9	541.4	209.5	27.2	−7.0
Japan	545.2	268.2	277.0	84.4	40.8
United States	673.7	1158.3	−484.6		−166.6

Standard indicators for bilateral resistance are symmetric with the implication that, the error component aside, trade should balance bilaterally. Our approach imposes no a priori structure, not even symmetry, on the pattern of bilateral trade.

Our exercise comes with two important disclaimers. First, it offers no explanation as to why current account deficits exist, or what market response or policy intervention would close them. Second, in focusing on trade in manufactures, we do not model trade in nonmanufactures. Since nonmanufactures include such diverse items as soy beans, crude oil, hip hop music, and patent royalties (for the last two, bilateral trade data are sparse), we defer modeling their determinants for future work. For now, we simply treat each country's nonmanufacturing trade surplus as a parameter that we take from the data.

I. World Equilibrium

Consider a world of N countries (n denoting an importer and i an exporter), a continuum of differentiated goods, and a constant elasticity of substitution (CES) aggregator. Under these conditions several theories of international trade lead to a gravity equation of the form:

$$\pi_{ni} = \frac{T_i(c_i d_{ni})^{-\theta}}{\sum_{k=1}^{N} T_k(c_k d_{nk})^{-\theta}}, \tag{1}$$

where π_{ni} is country i's share in country n's spending. Eaton and Kortum (2002, henceforth EK) derive such an expression in their equation (10), from a Ricardian model in which T_i reflects the absolute advantage of country i, c_i the cost of inputs there, and $d_{ni} \geq 1$ the additional cost of delivering goods to n from i. The parameter θ, which in the Ricardian model reflects comparative advantage, governs the sensitivity of demand to cost.[5]

We apply (1) to bilateral trade in manufactures. Multiplying it by total spending on manufactures in each country n, X_n^M, and summing across the destinations i sells to, gives us the goods market clearing conditions:

$$Y_i^M = \sum_{n=1}^{N} \pi_{ni} X_n^M, \tag{2}$$

where Y_i^M is country i's gross production of manufactures. Its manufacturing trade deficit is $D_i^M = X_i^M - Y_i^M$.

We denote the share of value added in manufacturing gross production as β. We can thus rewrite (1) as

$$\pi_{ni} = \frac{T_i (w_i^{\beta} p_i^{1-\beta} d_{ni})^{-\theta}}{\sum_{k=1}^{N} T_k (w_k^{\beta} p_k^{1-\beta} d_{nk})^{-\theta}}, \tag{3}$$

where w_i reflects factor costs and p_i the price index of manufactures used as intermediates in country i.

We treat intermediates as representative of all manufactures, so that p_i is also the manufacturing price index. EK (equation (16)) show that with a CES aggregator for manufactures:

$$p_n = \gamma \left[\sum_{i=1}^{N} T_i (w_i^{\beta} p_i^{1-\beta} d_{ni})^{-\theta} \right]^{-1/\theta}, \tag{4}$$

where γ is a constant common across countries.

We embed this model of world trade in manufactures into an aggregate framework, treating total factor supply in each country i, L_i, as exogenous. Under perfect competition, final output, or GDP, is $Y_i = w_i L_i$ while final spending is $X_i = Y_i + D_i$, where D_i is the overall trade deficit.

We follow Fernando Alvarez and Robert E. Lucas (2006) in treating final demand as an aggregate of manufacturers and nonmanufactures produced in the same factor proportions, calling the share of manufactures in final spending α. Summing final and intermediate demand for manufactures:

$$X_i^M = \alpha X_i + (1 - \beta) Y_i^M.$$

Substituting these expressions into (2), our market clearing conditions become

$$w_i L_i + D_i - \frac{1}{\alpha} D_i^M = \sum_{n=1}^{N} \pi_{ni} \left[w_n L_n + D_n - \frac{1-\beta}{\alpha} D_n^M \right]. \tag{5}$$

An equilibrium is a set of wages w_i and prices p_i that satisfies (3), (4), and (5).

Denoting the change in any variable x as $\hat{x} = x'/x$, where x' is its counterfactual value, we can solve for the required $\hat{w}$ and $\hat{p}$ under counterfactual trade imbalances D_i' and $D_i^{M'}$ from the market clearing and price expressions:

$$\hat{w}_i Y_i + D_i' - \frac{1}{\alpha} D_i^{M'} = \sum_{n=1}^{N} \frac{\pi_{ni} \hat{w}_i^{-\theta\beta} \hat{p}_i^{-\theta(1-\beta)}}{\sum_{k=1}^{N} \pi_{nk} \hat{w}_k^{-\theta\beta} \hat{p}_k^{-\theta(1-\beta)}} \times \left(\hat{w}_n Y_n + D_n' - \frac{1-\beta}{\alpha} D_n^{M'} \right) \tag{6}$$

and

$$\hat{p}_n = \left(\sum_{k=1}^{N} \pi_{nk} \hat{w}_k^{-\theta\beta} \hat{p}_k^{-\theta(1-\beta)} \right)^{-1/\theta}, \tag{7}$$

with initial world GDP as numeraire.[6]

We bring life to these equations using data on the original 2004 values of GDP for the Y's and trade shares for the π's. We set $\theta = 8.28$ as measured in EK (2002) using price data. (We also consider the lower value of $\theta = 3.60$ obtained in Bernard et al. 2003.) We base $\alpha = 0.188$ on the share of manufacturing in GDP and $\beta = 0.312$

[5] As EK (2002) point out, an equivalent functional form can emerge under Armington assumptions or monopolistic competition.

[6] It is straightforward, using Theorems 1, 2, and 3 of Alvarez and Lucas (2006), to prove that there is a unique solution for $\hat{w}$ and $\hat{p}$.

on the share of value added in manufacturing gross production.[7]

In the particular exercise we conduct here we ask what would happen if the manufacturing trade deficits had to adjust to set all current accounts to zero. That is, for each country n, we set

$$D_n^{M'} = D_n^M + CA_n,$$

where CA_n is country n's original current account surplus and D_n^M its original manufacturing trade deficit in 2004.[8]

The wage change for country i is simply $\hat{w}_i$ itself, which also equals that country's change in GDP. Country i's counterfactual GDP is hence $Y_i' = \hat{w}_i Y_i$. We can express the change in the real wage as $(\hat{w}_i/\hat{p}_i)^{\alpha}$. Taking into account the static gain or loss from setting the current account to zero, we get the change in welfare in country i as

$$\hat{W}_i = \left(\frac{\hat{w}_i}{\hat{p}_i}\right)^{\alpha} \frac{1 + D_i'/Y_i'}{1 + D_i/Y_i}.$$

The counterfactual value of n's imports from i is

$$X_{ni}' = \frac{\pi_{ni}\hat{w}_i^{-\theta\beta}\hat{p}_i^{-\theta(1-\beta)}}{\sum_{k=1}^{N}\pi_{nk}\hat{w}_k^{-\theta\beta}\hat{p}_k^{-\theta(1-\beta)}} \times \left[\frac{\alpha}{\beta}\,(Y_n' + D_n') - \frac{1-\beta}{\beta}D_n^{M'}\right].$$

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

$$\frac{V_i^{M'}}{Y_i'} = \frac{\alpha(Y_i' + D_i') - D_i^{M'}}{Y_i'}.$$

[7] The model implies $\alpha = (V_n^M + D_n^M)/(Y_n + D_n)$, where $V_n^M = \beta Y_n^M$ is manufacturing value added. We use data from the World Bank (2006) to calculate the ratio of manufacturing value added plus the trade deficit in manufactures to GDP plus the overall trade deficit on goods and services. Averaging this ratio across countries in our sample (for which data on manufacturing value added are available) yields $\alpha = 0.188$. We also get $\beta = V_n^M/Y_n^M$. From the United Nations Industrial Development Organization (2006) we have data for many of our countries on both manufacturing value added and manufacturing gross production. Averaging this ratio yields $\beta = 0.312$.

[8] We fix the components of the current account not involving trade in manufacturing. An implication is that in (6) each country's total counterfactual trade deficit is $D_n' = D_n^{M'} + D_n - D_n^M$.

Table 3—Consequences of Current Account Balance

	Implied change in		
	Wage	Real wage	Welfare
China/Hong Kong	1.025	1.001	1.043
Germany	1.031	1.002	1.042
Japan	1.037	1.001	1.039
United States	0.932	0.995	0.941

II. Results

Table 3 reports the changes to the wage, real wage, and welfare that our exercise claims are required to eliminate current account imbalances. These numbers imply less than a 4 percent increase for either China, Germany, or Japan, (the big surplus countries), and a 7 percent decline for the United States. In other words, achieving balance is associated with around a 10 percent decline in the value of the US dollar relative to the currencies of the big surplus countries (assuming the adjustment takes the form of an exchange rate realignment, holding fixed wages expressed in the local currency).

The associated changes in the real wage, reported in column 2, are negligible for these large countries. There are two reasons why the real wage effects are so attenuated: (a) due to "home bias" domestic manufactures, produced with local labor, dominate the manufacturing price index; and (b) with manufactures constituting less than 20 percent of final expenditure, the nontraded sector dominates the overall price index. Thus, in terms of purchasing power, citizens are largely insulated from potentially large swings in relative wages.

The third column reports the change in real expenditure taking into account the change in the deficit. Here the effects are more pronounced, largely dominated by the change in the current account itself. Together the second and third columns indicate a small "secondary burden" of adjusting current account deficits. Countries that must reduce their deficits experience a lower real wage, so real expenditure falls by more than the drop in transfers from abroad, with the opposite for countries that expand their deficits.

We have solved for wages in the new equilibrium of a 40 country trading system. How well could we have predicted each country's wage change just from its own 2004 current account balance? Figure 1 plots the wage change against

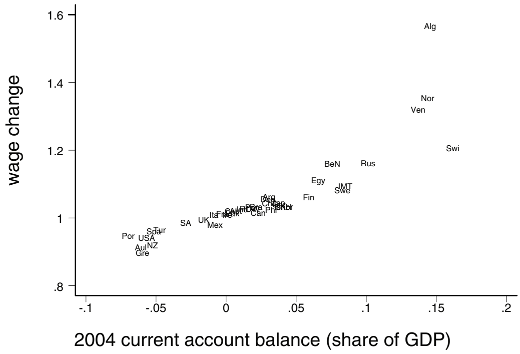

Figure 1. Current Account and Wage Change

Table 4—Actual and Counterfactual Bilateral Imbalance

	Balance with US		Balance with China	
	Actual	Counter-factual	Actual	Counter-factual
China/Hong Kong	166.6	64.9		
Germany	27.2	−30.8	−7.0	−8.6
Japan	84.4	−3.5	40.8	18.3
United States			−166.6	−64.9

the current account deficit (as a share of GDP). The relationship is generally upward sloping but with outliers. While Algeria, Norway, and Venezuela have smaller surpluses than Switzerland, relative to their GDP, they require much larger wage increases due to their relative isolation. At the other extreme, Portugal runs a larger deficit than Australia, Greece, or New Zealand, but needs less of a wage decline to adjust.

Table 4 reports the actual and counterfactual bilateral deficits for the United States and China. Note that the US deficit with Japan virtually disappears while the US deficit with Germany swings toward a significant surplus. A large US deficit with China nevertheless remains. At the same time, China continues to run a large deficit with Japan. There is room for large bilateral imbalances even in a world with overall balance.

A trade deficit in manufactures crowds out domestic manufacturing. Since our counterfactual experiment involves adjustments in manufacturing trade deficits, it has consequences for manufacturing's share of production. The share of manufacturing falls by 3 to 4 percentage points in China, Germany, and Japan. It rises by nearly 5 percentage points in the United States.

How much do our results depend on our choice of the parameter θ? Using the smaller value of $\theta = 3.60$ from Bernard et al. (2003) implies that more wage adjustment is necessary (since, in that case, trade shares are less responsive to factor costs). With this lower value, the US wage falls by 18 percent relative to that of China and by about 20 percent relative to that of Japan and Germany. With the smaller value of θ, the decline in the US real wage barely exceeds 1 percent. The implications for bilateral trade flows are nearly invariant to the choice of θ.

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