UNBALANCED TRADE

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ABSTRACT

We incorporate trade imbalances into a quantitative model of bilateral trade in manufactures, dividing the world into forty countries. Fitting the model to 2004 data on GDP and bilateral trade we calculate how relative wages, real wages, and welfare would differ in a counterfactual world with all current accounts balancing. Our results indicate that closing the current accounts requires modest changes in relative wages. The country with the largest deficit (the United States) needs its wage to fall by around 10 percent relative to the country with the largest surplus (Japan). But the prevalence of nontraded goods means that the real wage in Japan barely rises while the U.S. real wage falls by less than 1 percent. The geographic barriers implied by the current pattern of trade are sufficiently asymmetric that large bilateral deficits remain even after current accounts balance. The U.S. manufacturing trade deficit with China falls to $65 billion from its 2004 level of $167 billion.

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Theories of international trade typically assume trade balance. Yet any newspaper reader knows that trade is far from balanced, a source of great unease among the citizens of deficit countries. We incorporate imbalances into a quantitative model of trade flows to calculate what relative wages, real wages, the manufacturing share of GDP, and the pattern of bilateral trade would look like in a counterfactual world with all current accounts balancing. While our exercise does not point to what policy would eliminate the imbalances, it does suggest the magnitudes of the long-run adjustments that such a policy would entail.

We conduct our analysis using data for 2004 for the world, dividing it into forty "countries."[1] Table 1 lists the countries, their GDP's and several different external balance measures.[2] The table begins with the broadest measure, the current account balance, followed by the balance on goods and services, ending with the balance on manufactures.[3] The United States has by far the greatest current account imbalance, running a deficit of $664

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[1] We took the fifty largest, as measured by GDP in 2000, grouping all others into a "country" labeled ROW. Due to poor data we moved Saudi Arabia, Poland, Iran, the United Arab Emirates, Puerto Rico, and the Czech Republic into ROW as well. To mitigate the effect of entrepôt trade, which our approach here is ill-equipped to handle, we have 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. The result is forty entities, which we henceforth refer to as countries, spanning the globe.

[2] Sources are as follows: GDP is from the World Bank (2006), the current account balance and balance on goods and services are from IMF (2006), trade in manufactures (unilateral and bilateral) is from United Nations Statistics Division (2006). The most recent bilateral trade data are for 2004; hence all of our analysis is based on that year.

[3] A well known statistical discrepancy results in nonzero current account balances and trade balances for the world. For analytical reasons, we want to remove this discrepancy. Rather than force it all into ROW, we instead attributed one fortieth of it to each country. Since we measure bilateral trade in manufactures from the importer side, the trade balance of the world in manufactures is zero by construction.

billion or nearly 6 percent of its GDP.[4] The countries with the largest current account balances, Japan, Germany, and China (in that order), collectively run a surplus of $362 billion. For the largest players, the trade balance in manufactures is the main piece of the overall current account. It's the focus of our analysis here.

While unilateral imbalances command considerable attention, the U.S. obsession with China's trade suggests that bilateral trade imbalances are also a major concern. The last two columns of Table 1 report each country's bilateral trade surplus in manufactures with the United States and with China. Note that the U.S. 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 the world less the United States. Note in particular that China runs sizable deficits with many of its neighbors in the Asia Pacific region. Its largest deficit is with Japan. The United States runs deficits with most countries. Our analysis yields predictions about how these bilateral imbalances would respond to an elimination of unilateral current account imbalances.

Table 2 reports gross manufacturing exports and imports as well as the manufacturing trade balance. It also indicates what the manufacturing trade surplus would have to be in order to set current account balances to zero, holding fixed other components of the current account. Note that by far the largest adjustment is required for the United States, an increase in net exports of manufactures from a deficit of over $485 billion to a surplus

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[4]Among the deficit countries in 2004, the U.S. current account deficit is large even relative to GDP. Only Australia, Greece, and Portugal have larger deficit to GDP ratios. Several small countries run current account surpluses that are much larger fractions of their GDP's, however. The Bureau of Economics Analysis reports that the US current account deficit rose to $857 billion in 2006.

of $179 billion. The next largest adjustments are decreases in net manufacturing exports: Japan's and Germany's surpluses each fall to just over $100 billion while China's falls to $36 billion. In this paper we explore the implications of achieving this particular set of trade balances in manufactures.

Our methodology builds on a recent literature that integrates the gravity equation exhibited by bilateral trade flows into general equilibrium.[5] This research provides a framework for tracking the implications of various counterfactuals and policy experiments for different countries of the world, recognizing the role of trade barriers in fragmenting world markets. We put such a model of bilateral trade to work to assess the counterfactual experiment of simultaneously removing current account imbalances from each country. We examine the resulting bilateral imbalances, relative wages, real wages, welfare, and manufacturing's share in these forty economies.

While our theoretical framework is one that has been used before in modeling bilateral trade, we depart from a central feature of the gravity specification. The standard approach has used sundry geographical, 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 current bilateral trade data, letting the bilateral trade flows speak for themselves.[6]

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[5] Contributions include Eaton and Kortum (2002), Anderson and van Wincoop (2003), Redding and Venables (2004), and Chaney (2006).

[6] Equation (15) in Eaton and Kortum (2002) provides a hint that one can go a long way without imposing structure on trade costs. They show how the share of spending on domestic producers provides a simple statistic for a country's gains from trade. Furthermore Bernard, Eaton, Jensen, and Kortum (2003) show that the bilateral trade matrix was a sufficient statistic for the matrix of trade costs in simulating a model of individual producers in international competition. Recent work by Waugh (2007) pursues a related

A drawback of the standard approach for our analysis here is that the commonly used indicators for bilateral resistance are typically symmetric, often with the implication that, the error component aside, trade should balance bilaterally. By treating bilateral resistance as a parameter that we infer from data we impose no structure, not even symmetry, on the determinants of bilateral trade. China suggests a major deviation from symmetry with its large manufacturing trade surplus with the relatively distant United States in combination with its large deficits with its neighbors.

Our attempt to quantify the implications of eliminating current account deficits comes with two important disclaimers. First, our exercise is pure comparative statics. We offer no explanation for why the current account deficits exist or what market response or policy intervention would close them.[7] We simply use current data to parameterize a static model of bilateral trade flows and calculate the new equilibrium with zero deficits. We hope that at some point our framework can be integrated into a dynamic model that incorporates capital flows as well as flows of goods and services. 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, and patent royalties (for the last two, bilateral trade data are limited anyway) we defer modeling their determinants for future work. For now we simply treat each country's nonmanufacturing trade deficit as a parameter that we take from the data.

In this first respect our work resembles Obstfeld and Rogoff (2005), who also employ a static trade model to examine the implications of eliminating current account imbalances. Focusing on real exchange rates and the terms of trade, they ignore real wages and welfare,

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approach, in a model with capital accumulation, for assessing the contribution of trade to development.

[7]Padamitriou et al. (2006) provide an excellent review of the debate about the causes and consequences of the U.S. deficit.

which are central to our analysis. Furthermore their quantitative analysis employs a stylized three-region model with much symmetry imposed. In contrast, our framework can grapple with an arbitrary number of countries while capturing the asymmetries apparent in the GDP and trade data. We thus capture much more tightly geographic features of the world. Where comparable, our results are closest to what Obstfeld and Rogoff call a "very gradual" unwinding, or a decade-long adjustment.

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). We explore the connection between our analysis and this earlier literature in the Appendix, showing how a marriage of our techniques and theirs can deliver a sensible back-of-the envelope calculation about the implication removing a transfer from the rest of the world to the United States.

1   World Equilibrium

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

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

where π_{ni} is country i's share in country n's spending. Eaton and Kortum (2002) derive such an expression (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 "iceberg" 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.[8]

We apply this equation to bilateral trade in manufactures among our forty countries. Multiplying it by total spending on manufacturing in each country n, denoted by X_n^M, and summing across the destinations i sells to, gives us the goods market clearing conditions:

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

where Y_i^M is country i's gross production of manufactures.

If trade balances, as is often assumed, then $X_i^M = Y_i^M$. Since our focus here is on the yawning deficits and surpluses in manufactures, we don't impose this condition. Instead we simply acknowledge the deficits that we observe, $D_i^M = X_i^M - Y_i^M$ in our general-equilibrium formulation.

To recognize (i) that manufactures are only one component of final expenditure and (ii) that much of the gross output of manufactures goes into making manufactures we need two additional parameters. We denote the share of final spending on manufactures as α and the share of value added in manufacturing gross production as β. We are following Alvarez and Lucas (2006) in treating final demand as an aggregate of manufactures and nonmanufactures, with manufactures having a share α.

Denoting the price index of manufactures in country i as p_i, we can rewrite (1) as:

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

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[8] As Eaton and Kortum (2002) point out, equivalent formulations emerge under Armington assumptions, as in Anderson and van Wincoop (2003), or monopolistic competition, as in Redding and Venables (2004). In the first case T_i is the share of country i's goods in preferences while in the second it is the number of goods that country i produces. In either case, the parameter θ is replaced by $\sigma - 1$. Yet another formulation follows from specifying a Pareto distribution, with parameter θ, in the model of Melitz (2003), as in Chaney (2006).

where w_i reflects wages in country i.

Eaton and Kortum (2002) show (their equation (16)) that with a CES aggregator for manufactures the price index in country n is given by:

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

where γ is a constant that depends on only the parameters θ and σ. Thus we can rewrite the trade share (3) as:

$$(5) \quad \pi_{ni} = T_i \left(\frac{w_i^\beta p_i^{1-\beta} d_{ni}}{p_n/\gamma} \right)^{-\theta}.$$

We denote the total labor supply in country i as L_i, which we treat 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.[9] To connect final spending with production and spending on manufactures, we write total demand for manufactures by country i as the sum of final and intermediate demand:

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

Solving for manufacturing production yields

$$Y_i^M = \frac{\alpha}{\beta} \left[w_i L_i + D_i - \frac{1}{\alpha} D_i^M \right].$$

Adding D_n^M to Y_n^M gives country n's total purchases of manufactures:

$$X_n^M = \frac{\alpha}{\beta} \left[w_n L_n + D_n - \frac{1 - \beta}{\alpha} D_n^M \right].$$

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[9] Our analysis is consistent with an arbitrary number of factors as long as there are no systematic factor-intensity differences between manufactures and nonmanufactures. In this case L_i represents a (column) vector of factor endowments and w_i (when it multiplies L_i) a (row) vector of factor rewards or (when it appears without L_i) as an index of factor rewards. In keeping with the Ricardian origins of our model we nevertheless refer to the factor input as "labor" and its reward as the "wage."

Substituting these expressions into the goods market clearing conditions (2) we get:

$$(6) \quad w_i L_i + D_i - \frac{1}{\alpha} D_i^M = \sum_{n=1}^{N} \pi_{ni} \left[w_n L_n + D_n - \frac{1-\beta}{\alpha} D_n^M \right].$$

Taking as given (i) the trade imbalances D_i and D_i^M, (ii) labor supplies L_i, (iii) parameters of technology T_i, (iv) parameters of trade costs d_{ni}, and (v) parameters α, β, and θ, an equilibrium is a set of wages w_i and prices p_i that satisfy (4) and (6), with π_{ni} given by (5).

We can resolve for the equilibrium under counterfactual trade imbalances, denoted D_i' and $D_i^{M'}$. We denote the post adjustment value of any variable x as x' and the change in its value as $\widehat{x} = x'/x$. The counterfactual wages and prices must satisfy the market clearing condition:

$$w_i' L_i + D_i' - \frac{1}{\alpha} D_i^{M'} = \sum_{n=1}^{N} \frac{T_i (w_i')^{-\theta\beta} (p_i')^{-\theta(1-\beta)} d_{ni}^{-\theta}}{\sum_{k=1}^{N} T_k (w_k')^{-\theta\beta} (p_k')^{-\theta(1-\beta)} d_{nk}^{-\theta}} \left(w_n' L_n + D_n' - \frac{1-\beta}{\alpha} D_n^{M'} \right).$$

and the price equation

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

After some manipulation, these two sets of equations can be rewritten as:

$$(7) \quad \widehat{w}_i Y_i + D_i' - \frac{1}{\alpha} D_i^{M'} = \sum_{n=1}^{N} \frac{\pi_{ni} \widehat{w}_i^{-\theta\beta} \widehat{p}_i^{-\theta(1-\beta)}}{\sum_{k=1}^{N} \pi_{nk} \widehat{w}_k^{-\theta\beta} \widehat{p}_k^{-\theta(1-\beta)}} \left(\widehat{w}_n Y_n + D_n' - \frac{1-\beta}{\alpha} D_n^{M'} \right)$$

and

$$(8) \quad \widehat{p}_n = \left(\sum_{k=1}^{N} \pi_{nk} \widehat{w}_k^{-\theta\beta} \widehat{p}_k^{-\theta(1-\beta)} \right)^{-1/\theta}.$$

We use equations (7) and (8) to solve for the changes in wages $\widehat{w}$ and prices $\widehat{p}$ that maintain equilibrium under counterfactual assumptions about imbalances, using data on the original

values of GDP for the Y's and trade shares for the π's. What's neat about this representation is that, aside from GDP and bilateral trade data, we only need values for the three parameters α, β, and θ.

It is straightforward, using Theorems 1, 2, and 3 of Alvarez and Lucas (2006), to prove that there is a unique solution, vectors $\widehat{w}$ and $\widehat{p}$, to these equations, up to the normalization that

$$\sum_{i=1}^{N} \widehat{w}_i Y_i = Y,$$

i.e. world GDP Y is treated as the numeraire.

The particular exercise we conduct here is to 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:

$$D_n^{M\prime} = D_n^M + CA_n$$

where CA_n is country n's original current account surplus and D_n^M its original manufacturing trade deficit in 2004 (column 4 of Table 2 presents $-D_n^{M\prime}$).[10] In our counterfactual, we are fixing the values of the current account net of the manufacturing trade balance as well as the trade balance on goods and service net of the manufacturing trade balance. What that means is that these magnitudes are fixed as a fraction of world GDP.

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[10] In doing so, we set each country's total counterfactual trade deficit to:

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

2 Calibration and Computation

Aside from data on 2004 GDP's (for the Y's) and on 2004 trade shares (for the π's) to stick in (7) and (8), we need values for the parameters θ, α, and β.

We set $\theta = 8.28$ as estimated in Eaton and Kortum (2002) using price data. We also consider the lower value of $\theta = 3.60$ obtained in Bernard, Eaton, Jensen, and Kortum (2003).

We can calibrate α calculating for each country:

$$\alpha_n = \frac{\beta Y_n^M + D_n^M}{Y_n + D_n} = \frac{V_n^M + D_n^M}{Y_n + D_n},$$

where V_n^M is manufacturing value added (available for most of our countries from World Development Indicators). We 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 was available) yields $\alpha = 0.188$.

Notice that $\beta_n = V_n^M / Y_n^M$. From 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 $\beta = 0.312$.

A simple iterative procedure provides the solution $\widehat{w}$ and $\widehat{p}$. With 40 countries, running this procedure in GAUSS on a good quality laptop, the solution is obtained almost instantaneously.

For each country $i = 1, \ldots, 40$, we present the change in a set of outcomes, presented as the ratio of the counterfactual value to its original value. The wage change for country i is simply $\widehat{w}_i$ itself, which also equals that country's change in GDP. County i's counterfactual GDP is hence $Y_i' = \widehat{w}_i Y_i$. Since we also solve for $\widehat{p}_i$, we can express the change in the

real wage as $(\widehat{w}_i/\widehat{p}_i)^\alpha$. 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

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

Counterfactual bilateral trade share of country i in n can be constructed from the original shares using

$$\pi_{ni}' = \frac{\pi_{ni}\widehat{w}_i^{-\theta\beta}\widehat{p}_i^{-\theta(1-\beta)}}{\sum_{k=1}^N \pi_{nk}\widehat{w}_k^{-\theta\beta}\widehat{p}_k^{-\theta(1-\beta)}}.$$

Thus the counterfactual bilateral trade flow of n's imports from i is

$$X_{ni}' = \pi_{ni}' \left[\frac{\alpha}{\beta}\left(Y_n' + D_n'\right) - \frac{1-\beta}{\beta}D_n^{M'}\right].$$

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

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

3   Results

Table 3 reports the changes to relative wages, real wages, and welfare that our exercise claims are required to achieve the target manufacturing trade deficits reported in Table 2. Note that these numbers imply less than a 5 percent increase in the wage for either China, Germany, or Japan, the big surplus countries, and a 7 percent decline for the United States. In other words, despite the large U.S. trade deficit, the results imply that achieving balance is associated with a fairly modest 10 percent decline in the value of the U.S. dollar relative to the currencies of the big surplus countries (assuming the adjustment takes the form of an exchange rate realignment, holding wages fixed as 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. For one thing, the trade share data imply a huge "home bias" in manufacturing (that is, countries spend a disproportionately large amount on domestically produced goods) so that domestic manufactures, produced with local labor, dominate the manufacturing price index. For another, with manufactures constituting less than twenty percent of final expenditure, the nontraded sector dominates the overall price index.

The third column reports the change in real expenditure taking into account the change in the deficit. Here the effects are more pronounced, and 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. But the gain or loss of the transfer itself overwhelms the real wage adjustment in its effect on welfare.

We've 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 existing current account? Figure 1 plots the wage change in Table 3 against the current account deficit in Table 3 relative to GDP. The relationship is generally downward sloping but not monotonic. While Algeria and Norway have smaller surpluses than Switzerland relative to their GDP, they require a much larger wage increase due to their relative isolation. At the other extreme Portugal runs a larger deficit than Australia but needs less of a wage decline to adjust. The direction of the wage change is in accordance with the direction of the required balance except for France, where the wage goes up slightly despite its current deficit.

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 last column of Table 3 reports the change in the manufacturing share of GDP resulting from the closing of the current account deficit. The results indicate the largest increase in the United States, of 4.7 percentage points. The direction of the change is always predicted by the sign of the current account surplus, with deficit countries needing to produce more and surplus countries less. But the magnitudes are quite different as a consequence of the changes in relative market sizes implied by relative wage changes.

How does the overall adjustment get reflected in bilateral deficits for manufactures? Table 4 reports the actual and counterfactual bilateral deficits for both the United States and China with each other country. Note that the U.S. deficit with Japan and South Korea virtually disappear while the U.S. deficit with Germany swings toward a significant surplus. A large deficit with China nevertheless remains. At the same time China continues to run large deficits with Korea and Japan. These varied responses reflect asymmetries in the bilateral resistance measures indicated by current trade patterns. Projecting these asymmetries into post-adjustment world still means that there is enormous room for large bilateral imbalances even in a world with overall balance.

How much do our results depend on our choice of the parameter θ? Using the smaller value of $\theta = 3.60$ from BEJK (2003) implies that more wage adjustment is necessary (since, in that case, trade shares are less responsive to wages). With this lower value, the U.S. wage falls by 18 percent relative to the China's and by about 20 percent relative to Japan's and Germany's. Nevertheless the decline in the U.S. real wage barely exceeds 1 percent.

The implications for bilateral trade flows are nearly invariant to the choice of θ.[11]

4 Conclusion

We have asked what a static trade model has to say about the magnitudes of adjustments needed to close current account imbalances as they stood in 2004. By assumption the manufacturing sector bears the full burden of adjustment, which means that we are likely providing an upper bound on the required changes there. Given our baseline parameters, U.S. GDP must fall about seven percent relative to world GDP, while GDP in the major surplus countries rises by two to four percent. With a smaller elasticity (meaning trade shares are less responsive to costs), these adjustments are roughly doubled. In either case, the decline in real wages in the United States is muted, around one percent, since most goods can't be traded and even those that could be are often purchased from domestic producers in a large economy like the United States. According to our static analysis, the main welfare cost of eliminating the current account deficit is simply the loss of the free lunch, i.e. the loss of goods that we currently consume but do not pay for until later. That cost is on the order of six percent of GDP.

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[11]Our analysis does not acknowledge any delay in the response to the counterfactual experiment that we conduct. We have not introduced any frictions in getting from here to there. Ruhl (2005) provides an explicit dynamic model to reconcile the observed short-run and long-run responsiveness of trade flows to changes in policy. Our lower value of θ may better reflect a short-run response and the higher one a long-run response.

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A   A Two-Country Example

With just two countries our analysis collapses to a version of the two-country model of trade and unilateral transfers of Dornbusch, Fischer, and Samuelson (DFS, 1977). We show how that framework can be used to deliver a back-of-the-envelope calculation of the

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wage adjustment required to achieve a zero current account between the United States and the rest of the world.

Now the world consists of just two countries: the United States and ROW (denoted with a *). As above there are a continuum of goods $z \in [0, 1]$. Labor endowments are L and L^*. Following DFS we assume Cobb-Douglas preferences. Following their notation the productivity of labor in the United States relative to ROW is $A(z)$ where the goods are ordered so that $A(z)$ is decreasing in z. Markets are perfectly competitive. We treat the wage in ROW w^* as the numeraire.

If the relative wage of the United States is $\omega = w/w^*$ then the United States will produce goods $z \in [0, \bar{z}]$ and ROW will produce the rest, where the threshold good satisfies

(9) $A(\bar{z}) = \omega.$

To close the model we typically impose trade balance so that the value of US imports $I = (1 - \bar{z})wL$ equals the value of its exports $E = \bar{z}w^*L^*$, or

(10) $\omega = \dfrac{\bar{z}}{1 - \bar{z}}\dfrac{L^*}{L}.$

An equilibrium is a pair $(\omega, \bar{z})$ satisfying (9) and (10).

In fact, the same equilibrium arises if the United State runs a trade deficit, $D = I - E$. Then spending by the United States is $X = wL + D$ and spending by ROW is $X^* = w^*L^* - D$. Goods market clearing requires

$$(1 - \bar{z})(wL + D) = \bar{z}(w^*L^* - D) + D$$

which reduces to (10). The allocation of world production is determined by comparative advantage and has nothing to do with which country is spending more or less. This case captures the argument put forward by Ohlin.

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This neutrality arises because we have not introduced any home-bias in expenditures so what is transferred would have been spent the same way by transferrer and transferee. Suppose instead that consumers in both countries allocate a fraction α of their spending to tradable goods, with the rest spent on nontradables. Nontradables are produced with local labor under constant returns.

The goods market clearing condition becomes

$$\alpha(1 - \overline{z})(wL + D) = \alpha\overline{z}(w^*L^* - D) + D$$

or

$$(11) \quad \omega = \frac{\overline{z}}{1 - \overline{z}} \frac{L^*}{L} + \frac{(1 - \alpha)D}{\alpha(1 - \overline{z})w^*L}.$$

An equilibrium pair $(\omega, \overline{z})$ now must satisfy (9) and (11). Relative to $D = 0$, a positive deficit shifts up (11) for any given $\overline{z}$, thus leading to an equilibrium with a higher US relative wage ω and lower $\overline{z}$. The intuition is that a positive deficit increases US spending and hence spending on nontradables. To meet this extra demand US workers shift out of the tradables sector and into the nontradables sector. As they do so, remaining workers in the tradable sector specialize in producing a narrower range of products, for which US relative productivity is higher. Thus, the relative wage of US workers goes up.

The share of US GDP originating in the tradables sector is

$$\lambda = \frac{\alpha\overline{z}(wL + w^*L^*)}{wL} = \alpha\overline{z}\left(1 + \frac{L^*}{\omega L}\right).$$

Relative to the case of $D = 0$, this share is lower if $D > 0$. The deficit crowds out the tradable sector.

What is less apparent in the model, yet perhaps more important, is what happens to the US real wage. A small share of tradables α, which is a necessary condition for the

deficit to have large effects on the relative wage, also implies a large share of spending on goods whose price exactly parallels changes in the wage. Thus, real wage changes will arise only through tradables. And, in a big country like the United States, even many tradable goods are purchased locally. We now parameterize a version of the DFS model that renders it the two-country version of the model considered in the main text.

The parameterized probabilistic formulation of the Ricardian model developed in Eaton and Kortum (2002) projects onto a 2-country worlds as

$$A(z) = \left(\frac{T}{T^*}\right)^{1/\theta} \left(\frac{1-z}{z}\right)^{1/\theta}.$$

Hence, from (9) we have

$$\overline{z} = \frac{T\omega^{-\theta}}{T\omega^{-\theta} + T^*}.$$

Consider the equilibrium $(\omega, \overline{z})$ resulting from the current deficit of D, generating observed GDP's of $Y = wL$ and $Y^* = w^*L^*$. Under some counterfactual deficit D' the resulting equilibrium would be $(\omega', \overline{z}')$. Letting $\widehat{\omega} = \omega'/\omega$, the counterfactual equilibrium must satisfy

$$\overline{z}' = \frac{T\omega'^{-\theta}}{T\omega'^{-\theta} + T^*} = \frac{\overline{z}\widehat{\omega}^{-\theta}}{\overline{z}\widehat{\omega}^{-\theta} + (1-\overline{z})}.$$

and

$$(1-\overline{z}')(Y\widehat{\omega} + D') = \overline{z}'(Y^* - D') + D'/\alpha.$$

Consider the counterfactual $D' = 0$ so that the change in the relative wage satisfies

$$(1-\overline{z}')Y\widehat{\omega} = \overline{z}'Y^*$$

or

$$(1-\overline{z})Y\widehat{\omega} = \overline{z}\widehat{\omega}^{-\theta}Y^*$$

or

$$\widehat{\omega} = \left(\frac{\overline{z}Y^*}{(1 - \overline{z})Y} \right)^{1/(1+\theta)}$$

Using data for the United States in 2006 (in US\$ trillions) we have $Y = 13.2$, $Y^* = 33.9$, $E = 1.4$, $I = 2.2$, and $D = 0.8$.[12] Furthermore, according to the model

$$\frac{\overline{z}}{1 - \overline{z}} = \frac{E/(Y^* - D)}{I/(Y + D)} = 0.27$$

(hence $\overline{z} = 0.21$ and $\alpha = 0.2$). Using the estimate of $\theta = 8.28$ from Eaton and Kortum (2002) we find $\widehat{\omega} = 0.96$, approximately a 4% decline in the US relative wage. Using the value of $\theta = 3.60$ from BEJK (2003) yields $\widehat{\omega} = 0.92$. In either case this change in relative wages is largely cushioned by a change in prices so that the real wage in the United States does not fall much.

To see the effect on prices we need to take a stand on labor requirements in each country. A natural specification consistent with our specification of $A(z)$ is

$$a(z) = T^{-1/\theta} z^{1/\theta}$$

and

$$a^*(z) = T^{*-1/\theta}(1 - z)^{1/\theta}.$$

In the United States, the resulting prices of tradables are $p(z) = wa(z)$ for $z \leq \overline{z}$ and $p(z) = w^* a^*(z)$ for $z \geq \overline{z}$. Integrating over these prices, the exact price index for tradables in the United States (given Cobb-Douglas preferences) is

$$p = e^{-1/\theta} \left[Tw^{-\theta} + T^* w^{*-\theta} \right]^{-1/\theta}.$$

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[12] These numbers are from the Bureau of Economic Analysis except for GDP in ROW which was taken from World Bank (2006), assuming that world GDP grew at the same rate as US GDP from 2005 to 2006.

Letting the counterfactual price index be p' and $\widehat{p} = p'/p$, we get

$$\widehat{p} = \left[\overline{z}\,\widehat{\omega}^{-\theta} + (1 - \overline{z}) \right]^{-1/\theta}.$$

Taking into account non-tradables, the change in the real wage is $(\widehat{\omega}/\widehat{p})^\alpha$. The U.S. real wage declines by a bit less than 1 percent for $\theta = 8.28$ and a bit more than 1 percent for $\theta = 3.60$. In either case, the tradables sector share of GDP rises 3 percentage points.

Table 1: Trade Imbalances

	COUNTRY	GDP	Current Account balance (US$ bill.)	Current Account balance (% GDP)	Goods & services balance	Manufactures Unilateral balance	Manufactures Bilateral balance w/ US	Manufactures Bilateral balance w/ China
Alg	Algeria	85.0	12.4	14.6	3.1	-13.2	-0.6	-0.9
Arg	Argentina	153.0	4.7	3.1	7.2	-10.3	-1.8	-0.9
Aul	Australia	637.3	-38.8	-6.1	-23.2	-60.3	-10.4	-10.1
Aut	Austria	292.3	2.0	0.7	1.3	-1.1	1.8	-0.8
BeN	BelLuxNeth	963.2	73.0	7.6	60.7	-63.7	-17.4	-19.4
Bra	Brazil	604.0	13.0	2.2	24.5	5.8	5.7	-1.8
Can	Canada	978.0	22.4	2.3	35.9	-26.9	29.2	-13.9
Chl	Chile	95.0	2.8	3.0	4.0	-1.9	-1.2	0.3
ChH	ChinaHK	2097.6	85.6	4.1	59.5	121.8	166.6	0.0
Col	Colombia	96.8	0.3	0.3	-4.8	-8.4	-2.4	-1.1
Den	Denmark	241.4	7.2	3.0	7.9	-9.5	1.2	-1.8
Egy	Egypt, Arab Rep.	78.8	5.2	6.6	-4.9	-1.2	0.4	-0.5
Fin	Finland	185.9	11.0	5.9	6.0	14.4	1.6	0.5
Fra	France	2046.7	-5.6	-0.3	-2.1	-5.3	1.2	-11.3
Ger	Germany	2740.6	103.0	3.8	131.4	209.5	27.2	-7.0
Gre	Greece	205.2	-12.2	-6.0	-17.1	-29.5	-1.7	-1.7
Ind	India	694.7	8.1	1.2	-15.7	5.4	9.1	-0.8
IMT	IndonMalySingThai	641.8	54.6	8.5	55.0	19.6	24.0	18.8
Ire	Ireland	181.6	0.2	0.1	21.8	66.2	18.1	-2.0
Isr	Israel	116.9	4.4	3.8	-4.1	-0.7	8.8	-0.5
Ita	Italy	1677.8	-14.5	-0.9	7.7	21.2	15.0	-5.0
Jap	Japan	4622.8	173.3	3.7	89.7	277.0	84.4	40.8
Kor	Korea, Rep.	679.7	29.4	4.3	25.0	82.1	22.8	43.4
Mex	Mexico	683.5	-5.4	-0.8	-19.0	-22.0	27.9	-12.3
NZ	New Zealand	98.9	-5.2	-5.3	-5.1	-11.0	-1.3	-1.8
Nor	Norway	250.1	36.0	14.4	31.6	-16.4	-0.2	-1.8
Pak	Pakistan	96.1	0.4	0.5	-10.5	-0.4	1.8	-0.3
Per	Peru	68.7	1.2	1.8	-2.6	-2.7	0.4	-0.7
Phi	Philippines	90.1	2.9	3.2	-12.0	13.5	0.7	8.9
Por	Portugal	167.7	-11.7	-7.0	-18.0	-10.7	0.9	-0.3
Rus	Russian Federation	590.4	59.8	10.1	67.9	7.7	4.7	0.8
SA	South Africa	214.7	-6.2	-2.9	-6.1	-2.9	1.7	-1.8
Spa	Spain	1039.9	-53.6	-5.2	-44.3	-62.8	-1.1	-8.7
Swe	Sweden	346.4	28.7	8.3	24.6	23.2	8.0	0.5
Swi	Switzerland	357.5	57.8	16.2	30.0	9.5	5.3	3.8
Tur	Turkey	302.8	-14.3	-4.7	-15.6	-18.7	1.5	-3.8
UK	United Kingdom	2124.4	-33.9	-1.6	-68.5	-109.2	3.8	-21.0
USA	United States	11711.8	-664.0	-5.7	-615.8	-484.6	0.0	-166.6
Ven	Venezuela, RB	110.1	15.1	13.7	13.3	-6.2	-1.8	-0.3
ROW	Rest of World	2996.7	50.7	1.7	181.2	102.6	50.9	59.5

* All data are for 2004 in US$ billions (unless labeled otherwise)

Table 2: Trade in Manufactures

	Gross trade		Trade balance	Counterfactual balance
	Exports	Imports		
Algeria	0.5	13.7	-13.2	-25.5
Argentina	10.4	20.6	-10.3	-14.9
Australia	25.0	85.2	-60.3	-21.4
Austria	82.4	83.5	-1.1	-3.1
BelLuxNeth	307.8	371.6	-63.7	-136.8
Brazil	53.2	47.4	5.8	-7.2
Canada	198.2	225.0	-26.9	-49.3
Chile	13.5	15.4	-1.9	-4.7
ChinaHK	816.8	695.0	121.8	36.2
Colombia	6.0	14.4	-8.4	-8.7
Denmark	42.6	52.2	-9.5	-16.7
Egypt, Arab Rep.	5.5	6.7	-1.2	-6.4
Finland	50.5	36.2	14.4	3.4
France	333.0	338.2	-5.3	-0.3
Germany	750.9	541.4	209.5	106.5
Greece	9.3	38.9	-29.5	-17.3
India	58.5	53.1	5.4	-2.7
IndonMalySingThai	279.1	259.5	19.6	-35.1
Ireland	115.2	49.1	66.2	66.0
Israel	32.3	32.9	-0.7	-5.1
Italy	278.3	257.1	21.2	35.6
Japan	545.2	268.2	277.0	103.7
Korea, Rep.	228.4	146.3	82.1	52.6
Mexico	148.1	170.1	-22.0	-16.6
New Zealand	6.6	17.6	-11.0	-5.8
Norway	22.8	39.2	-16.4	-52.4
Pakistan	10.0	10.5	-0.4	-0.9
Peru	4.0	6.7	-2.7	-3.9
Philippines	48.8	35.3	13.5	10.6
Portugal	29.9	40.6	-10.7	-1.0
Russian Federation	59.1	51.4	7.7	-52.2
South Africa	30.0	32.9	-2.9	3.3
Spain	132.0	194.7	-62.8	-9.1
Sweden	100.3	77.1	23.2	-5.5
Switzerland	106.6	97.1	9.5	-48.4
Turkey	51.0	69.6	-18.7	-4.3
United Kingdom	254.5	363.7	-109.2	-75.3
United States	673.7	1158.3	-484.6	179.4
Venezuela, RB	5.7	11.9	-6.2	-21.3
ROW	746.5	643.9	102.6	51.9

* All data are for 2004 in US$ billions.

Table 3: Consequences of Counterfactual Current Account Balance

	Ratio change in			Change in mfg. share
	Relative wage	Real wage	Welfare	
Algeria	1.558	1.078	1.198	-1.8
Argentina	1.054	1.006	1.039	-2.0
Australia	0.904	0.990	0.929	4.5
Austria	1.012	0.999	1.006	-0.5
BelLuxNeth	1.152	1.025	1.106	-4.3
Brazil	1.024	1.002	1.024	-1.7
Canada	1.006	1.005	1.029	-1.8
Chile	1.035	1.004	1.036	-2.3
ChinaHK	1.025	1.001	1.043	-3.4
Colombia	1.011	1.002	1.004	-0.2
Denmark	1.046	1.003	1.034	-2.1
Egypt, Arab Rep.	1.102	1.007	1.058	-4.8
Finland	1.052	1.003	1.063	-4.9
France	1.004	0.999	0.997	0.2
Germany	1.031	1.002	1.042	-3.2
Greece	0.888	0.981	0.930	3.8
India	1.017	1.000	1.011	-1.0
IndonMalySingThai	1.084	1.012	1.107	-6.5
Ireland	1.000	1.000	1.001	-0.1
Israel	1.024	1.002	1.037	-3.0
Italy	1.000	0.999	0.990	0.7
Japan	1.037	1.001	1.039	-3.1
Korea, Rep.	1.024	1.002	1.046	-3.7
Mexico	0.971	0.999	0.992	0.6
New Zealand	0.911	0.989	0.940	3.7
Norway	1.345	1.042	1.208	-6.4
Pakistan	1.005	1.000	1.003	-0.4
Peru	1.023	1.002	1.018	-1.4
Philippines	1.015	1.001	1.028	-2.8
Portugal	0.939	0.991	0.931	5.8
Russian Federation	1.152	1.011	1.129	-7.0
South Africa	0.977	0.997	0.969	2.4
Spain	0.952	0.993	0.943	4.1
Sweden	1.073	1.006	1.095	-6.6
Switzerland	1.198	1.025	1.192	-11.1
Turkey	0.957	0.992	0.948	3.8
United Kingdom	0.986	0.997	0.982	1.3
United States	0.932	0.995	0.941	4.7
Venezuela, RB	1.311	1.038	1.195	-6.6
ROW	1.018	1.000	1.019	-1.4

* The first three columns report the changes as x'/x,
   where x' is the counterfactual value. The last column
   reports the change in terms of percentage points.

Table 4: Actual and Counterfactual Bilateral Imbalance

	Balance with the US		Balance with China	
	Actual	C\factual	Actual	C\factual
Algeria	-0.6	-2.0	-0.9	-1.5
Argentina	-1.8	-4.8	-0.9	-1.0
Australia	-10.4	-11.3	-10.1	-2.7
Austria	1.8	-2.3	-0.8	-0.8
BelLuxNeth	-17.4	-44.8	-19.4	-18.0
Brazil	5.7	-7.1	-1.8	-1.7
Canada	29.2	-23.7	-13.9	-7.1
Chile	-1.2	-3.5	0.3	0.3
ChinaHK	166.6	64.9		
Colombia	-2.4	-5.0	-1.1	-0.9
Denmark	1.2	-1.9	-1.8	-2.1
Egypt, Arab Rep.	0.4	-0.9	-0.5	-0.8
Finland	1.6	-1.6	0.5	-0.3
France	1.2	-22.5	-11.3	-9.3
Germany	27.2	-30.8	-7.0	-8.6
Greece	-1.7	-2.5	-1.7	-1.3
India	9.1	0.4	-0.8	-0.9
IndonMalySingThai	24.0	-24.0	18.8	13.6
Ireland	18.1	7.9	-2.0	-1.2
Israel	8.8	1.3	-0.5	-0.3
Italy	15.0	1.9	-5.0	-3.6
Japan	84.4	-3.5	40.8	18.3
Korea, Rep.	22.8	-6.5	43.4	40.5
Mexico	27.9	2.9	-12.3	-7.2
New Zealand	-1.3	-1.6	-1.8	-0.8
Norway	-0.2	-5.3	-1.8	-3.7
Pakistan	1.8	0.3	-0.3	-0.2
Peru	0.4	-1.1	-0.7	-0.6
Philippines	0.7	-5.9	8.9	9.3
Portugal	0.9	0.4	-0.3	-0.1
Russian Federation	4.7	-4.0	0.8	-4.0
South Africa	1.7	-0.9	-1.8	-0.7
Spain	-1.1	-5.3	-8.7	-6.7
Sweden	8.0	-0.1	0.5	-0.7
Switzerland	5.3	-5.6	3.8	0.6
Turkey	1.5	-1.1	-3.8	-3.4
United Kingdom	3.8	-22.5	-21.0	-17.0
United States			-166.6	-64.9
Venezuela, RB	-1.8	-9.9	-0.3	-0.6
ROW	50.9	2.6	59.5	54.0

* All values are in US$ billions.

Table 5: Counterfactual Using a Lower Trade Elasticity

| | Ratio change in | | | Change in mfg. share | Counterfactual balance | |
	Relative wage	Real wage	Welfare		with US	with China
Algeria	1.624	1.082	1.198	-1.1	-2.0	-1.5
Argentina	1.099	1.010	1.044	-1.6	-4.7	-1.0
Australia	0.823	0.979	0.917	4.1	-10.5	-2.8
Austria	1.031	0.999	1.006	-0.5	-2.2	-0.8
BelLuxNeth	1.224	1.034	1.115	-3.6	-46.9	-19.7
Brazil	1.053	1.003	1.027	-1.7	-6.9	-1.8
Canada	1.006	1.009	1.033	-1.8	-23.2	-7.3
Chile	1.071	1.007	1.040	-2.1	-3.5	0.3
ChinaHK	1.055	1.003	1.044	-3.4	63.6	
Colombia	1.023	1.003	1.005	-0.1	-4.8	-1.0
Denmark	1.092	1.006	1.037	-1.8	-1.8	-2.1
Egypt, Arab Rep.	1.205	1.012	1.054	-4.4	-0.8	-0.8
Finland	1.118	1.007	1.066	-5.0	-1.6	-0.3
France	1.013	0.999	0.996	0.2	-21.8	-9.6
Germany	1.072	1.005	1.045	-3.3	-30.6	-9.2
Greece	0.819	0.968	0.919	3.1	-2.3	-1.2
India	1.038	1.001	1.011	-1.0	0.5	-0.8
IndonMalySingThai	1.156	1.021	1.117	-6.2	-24.4	14.7
Ireland	1.009	1.001	1.003	-0.4	7.1	-1.3
Israel	1.049	1.004	1.038	-2.9	1.5	-0.3
Italy	1.004	0.997	0.989	0.7	1.9	-3.6
Japan	1.085	1.003	1.040	-3.2	-4.6	17.4
Korea, Rep.	1.057	1.004	1.048	-3.9	-6.7	41.0
Mexico	0.940	0.998	0.992	0.5	2.9	-7.2
New Zealand	0.843	0.980	0.930	3.2	-1.5	-0.9
Norway	1.499	1.053	1.219	-4.8	-5.1	-3.8
Pakistan	1.013	0.999	1.002	-0.4	0.3	-0.2
Peru	1.047	1.004	1.019	-1.3	-1.1	-0.6
Philippines	1.041	1.004	1.026	-3.2	-5.9	9.3
Portugal	0.885	0.983	0.925	5.8	0.3	-0.1
Russian Federation	1.301	1.019	1.140	-6.1	-3.7	-3.9
South Africa	0.958	0.994	0.967	2.4	-0.9	-0.8
Spain	0.910	0.986	0.936	4.1	-4.9	-6.6
Sweden	1.157	1.012	1.101	-6.6	0.0	-0.7
Switzerland	1.354	1.041	1.201	-10.0	-5.6	1.0
Turkey	0.922	0.985	0.941	3.7	-1.1	-3.3
United Kingdom	0.978	0.995	0.980	1.2	-21.4	-17.1
United States	0.865	0.989	0.935	4.8		-63.6
Venezuela, RB	1.476	1.051	1.209	-5.0	-9.7	-0.6
ROW	1.042	1.001	1.021	-1.4	2.4	54.6

* The results in this table are based on "theta" of 3.60 (whereas all other results use 8.28)..
  The first three columns report the changes as x'/x, where x' is the counterfactual value.
  The fourth column reports the change in terms of percentage points.
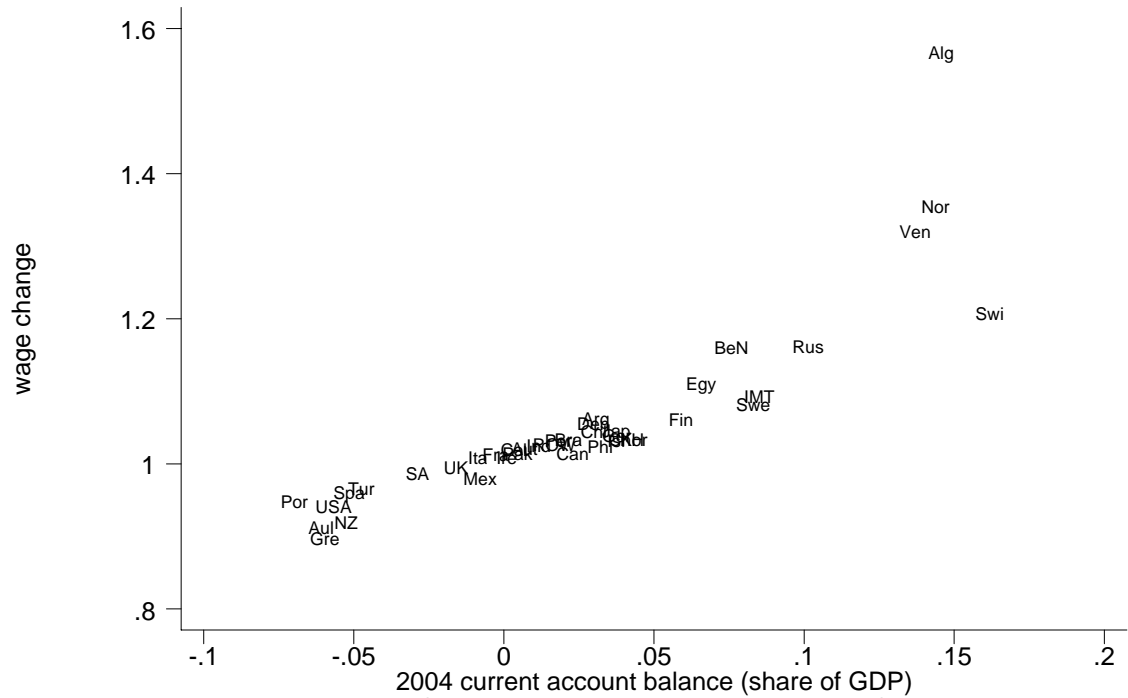 The last two columns report the counterfactual values themselves (in US$ billions).

Figure 1: Current Account and Wage Change