Short-Run Adjustment in a Global Model of Current Account Imbalances*

Rudiger von Arnim

May 31, 2007

Abstract

We suggest a static global demand–led general equilibrium model with imperfect competition in four regions (United States, Europe, Asia and oil exporting countries) and two sectors (tradables and non-tradables) to examine possible adjustment scenarios to the infamously mounting global imbalances.

Changing causality assumptions in the external balance allows us to investigate the impact of changes in US–household behavior, changes in demand for US Dollar–denominated assets, a loss of confidence in the US Dollar, variations in the price of oil and a US recession. We analyze the build–up of imbalances, their correction and how policy might prevent a global recession in view of adverse shocks. Results suggest that no exchange rate changes—nominal or real—will prevent adjustment in real incomes. Further, if an adverse shock occurs the US might be ill–advised to contribute to the contraction by reducing the public deficit, and EU–members might have an interest in abandoning arbitrary budgetary ceilings in order to sustain the current expansion even in the face of a US downturn.

1 Introduction

The United States have been posting successive record trade deficits for more than a decade. Each data release, stating astounding numbers for the current account deficit in excess of 5% of GDP and a build–up of net foreign debt of roughly 40%[1] relative to GDP, was and is accompanied by the questions (1) how the deficit could rise to such extreme levels, (2) how it could be maintained at these levels for many years, and, obviously, (3) how adjustment is going to come about.

With regard to (1) and (2), often suggested reasons are on the one hand the insatiable appetite of the US–consumer, and, on the other hand, of foreign investors for US–Dollar–denominated securities. Importing consumer goods and parts and components from Europe, Japan, the rising giant China and other, more established, exporters in Asia drives the deficit from the real side. Additionally, since 2002, higher oil prices have increased the share of petroleum imports in total imports to 15%, a level not seen since the mid–1980ies. On the financial side, liquidity and "safety"

*New School University and Schwartz Center for Economic Policy Analysis, New York. Email: VONR605@newschool.edu. I am grateful to Lance Taylor for his advice and guidance, without whom there would not only be no CGE–modeling, but this one not either.

[1] The cumulative current account balance exceeds 40% percent of GDP. Other measures, which account for changes in asset prices, show lower values, roughly around 25%.

were in high demand following the fall of the twin towers, the bursting asset bubble and the ensuing recession. The Federal Reserve, still under Greenspan, kept the valve wide open to avoid any serious repercussions in the real economy. Subsequently, private investors' demand for US–Dollar–denominated securities was outpaced by foreign monetary authorities, who began stockpiling treasuries, even if for a variety of reasons. China and possibly others are engaged in building up a wall of capital to be able to defend undervalued exchange rates, with the most likely welcome side–effect of low long–term dollar interest rates. The oil exporting countries are better described as recycling windfall revenues from high oil prices.

Domestically, the ample liquidity provided both by the Central Bank and foreign bond purchases fed an already "frothy" housing market, which is currently in the midst of a deflation. Residential investment is in full contraction, and employment in the construction sector is most likely going to follow throughout 2007. In the meantime the Japanese authorities are still scrambling to finally get out of the deflationary trap, but cheap Yen are short–sold on a massive scale and invested in high–yield currencies, a practice commonly referred to as carry trades. To boot, unequaled growth in derivative instruments further fuels the liquidity bubble, creating fundamental uncertainty about how a shock might permeate through the system.

Now, adjustment appears to be under way. Since the first quarter of 2002, the US Dollar has depreciated more than 20% in real effective terms.[2] This turning point in the trend of the Dollar coincides with a slight stabilization of the current account, which *excluding oil imports* has not worsened for almost two years. On the financial side, depreciation of the Dollar improves the current account through the income channel: capital gains on US–owned foreign currency denominated assets abroad increase, and combine with the return–oriented US–portfolio structure to promote a smooth adjustment. These effects have been discussed at length in the literature,[3] and emphasize the importance of asset price or demand changes for countries with an open capital account. Large and increasing cross–border equity and greenfield investments through multinational corporations hint at the relevance of net foreign asset positions for exchange adjustments.

It is not a simple endeavor to develop coherent causal storylines in a world with highly interdependent real as well as financial markets. What drives "market–determined" exchange rates remains a conundrum, as the US Dollar appreciated between the mid–Nineties and early 2002, evidently outright confuting both a Humean exchange rate response to trade as well as uncovered interest parity.

The difficulties economists have sorting through data generated by an increasingly complex, globalized world are bypassed by imposing causal schemes that "help" to explain correlations and serve as basis for a discussion of (3) above—the question how the unraveling might come about. A much discussed, but certainly somewhat outlying opinion is that adjustment does not have to happen. First, the "Deutsche Bank"–view,[4] often dubbed Bretton Woods II, claims that the Chinese government needs to maintain an undervalued exchange rate in order to provide employment

[2] Exchange rate statistics are from IMF International Financial Statistics.

[3] See Lane and Milesi-Ferretti (2004), Lane and Milesi-Ferretti (2006b) and Gourinchas and Rey (2007).

[4] The author's various papers on the topic are collected in Dooley et al. (2005).

opportunities for the vast amounts of rural surplus labor for years to come, in order to promote political stability. Authorities therefore willingly accept possible losses on reserve holdings following a revaluation in the future in order to reap the real gains now: growth, industrialization and development. Secondly, Hausmann and Sturzenegger (2005) suggest that US brands as well as management techniques are so vastly superior to the rest of the world's that the US' high returns on investments abroad stabilize the deficit. In fact, the US' exceptional "intangibles" form *dark matter*, which renders the trade deficit and debt accumulated a wrongly calculated statistic!

In my view, for once in the middle of the mainstream, international adjustment is going to come as sure as any business cycle is going to bottom out. A series of papers have suggested that an important driver of global imbalances are US household saving– and investment characteristics.[5] Decompositions of net borrowing flows by sectors—public, corporate, household and foreign—suggest that the external deficit is largely driven by incessant excess expenditures of households. High residential investment rates, high consumption levels and rising healthcare costs on the one hand and aggressive lending practices on the other contribute to soaring private debt levels. Once the credit cycle ends, this time around possibly with a noticeable bust from subrime mortgages, domestic saving patterns might change, with global consequences.

On the contrary, a quite public figure has expounded the position that imbalances are largely driven by global excess saving. Federal Reserve chairman Ben Bernanke first offered this hypothesis in a speech,[6] saying "that over the past decade a combination of diverse forces has created a significant increase in the global supply of saving—a global saving glut—which helps to explain both the increase in the US current account deficit and the relatively low level of long–term real interest rates in the world today." The idea has been taken up by numerous economists, including the Financial Times' Martin Wolf and many of his prominent online–discussants. As we will see below, the various author's cited in the preceding paragraph and Bernanke agree on the data—where to situate causality is the question, and the model suggested here allows to structure that flexibly. Obviously, such priors matter. Efforts as Lardy (2007) build on Bernanke's hypothesis of causality, arguing that China needs to save less, consume more—possibly government–led, and revalue its currency, whereas others assert that while universal healthcare for every Chinese is a desirable goal, the US does not get around addressing its domestic problems, particularly stagnating real income growth and escalating household indebtedness for more than 90% of the populace.

It is well worth emphasizing why these models are so fundamentally different. The Bernanke–argument fits well into modern open–economy macroeconomics, where payments imbalances are *optimal* as the result of given intertemporal preferences of *hominum oeconomicuum* for consumption and saving. Thus, East Asians just want to save much more, whereas US–citizens just want to consume much more, and, as standard in micro–founded thinking, the whole exchange has to be the best possible, because otherwise nobody would do it. The perspective adopted here, broadly Keynesian, is that agents are not rational, and do not weigh preferences intertemporally,

[5] See Barbosa-Filho et al. (2005), Barbosa-Filho et al. (2007), Papadimitrou et al. (2006), Godley and Zezza (2006) and Godley et al. (2005).

[6] See Bernanke (2005). The speech is available at http://www.federalreserve.gov

but act rather adaptively in a constantly changing environment, given their "local" information. Significantly, part of Tom's, Dick's and Harry's expectation throughout the last few decades has been that there is always the next credit card, and that even a major stock market crash will not affect him or her negative.

While most of these studies are empirical, some recent modeling efforts try to take account of persistent and highly imbalanced foreign asset positions. Blanchard et al. (2005) and Obstfeld and Rogoff (2007) analyze the interaction between the current and capital account, the former arriving at saddle point dynamics between the exchange rate and net debt position, the latter endogenizing the capital account in a traded/non–traded goods model. Lane and Milesi-Ferretti (2006a) and Faruqee et al. (2007) use the IMF's Global Economic Model, where only the former "tag on" a financial adjustment channel.[7] The key finding of this research is that a substantial further real depreciation is necessary to balance trade—especially in order to *avoid income adjustment*. None of these models get around causal assumptions. All are full employment models. All are real side models; and maybe most importantly, are structured such that adjustment in prices carries the day, as opposed to quantity–driven adjustment.

We aim to shed some light on possible price– and quantity–changes within the short– to medium–run *under differing causal schemes*. The model is essentially a simple demand–driven general equilibrium model of three economies (US, Europe and Asia),[8] linked by international trade flows financed by foreign saving. The model features imperfect competition, where each country has a degree of price–setting power and the elusive law of one price fails to hold. Labor and capital are subject to decreasing returns, a convenient assumption we accept here as standard. We do not model financial markets and stock accumulation, but argue that shocks to saving flows are an appropriate proxy in an already large model.

Changing endogeneity assumptions—usually referred to as changing "closures" after Taylor and Lysy (1979)—enables us to investigate a variety of shocks to investment, foreign and domestic saving, exchange rates, oil prices etc.

The remainder of the paper is organized as follows. In section 2 we discuss the data. Section 3 lays out a simplified one–sector, one–country version of the model, mostly to provide some guidance for reading the following analysis. In section 4 we describe selected simulations to delineate the key mechanisms of the model. In section 5 we investigate a variety of shocks that lead global imbalances and domestic demand patterns from the base–year level of 2001 to 2006. Section 6 discusses how adverse shocks might rattle the system. Section 7 concludes with possible policy responses.

2 Accounting for global flows

In this section we discuss the data and how we account for it in a set of Social Accounting Matrices (SAMs). Data source is GTAP 6 database from the Center for Global Trade Analysis at Purdue

[7] See as well the most recent World Economic Outlook, IMF (2007).

[8] The model allows to switch to a supply–driven full employment configuration. Due to time and space limits we focus on the Keynesian model here.

University. This most recent version of the database offers data on 87 regions and 57 sectors,[9] covering a lot of ground.[10]

What is the right level of aggregation? The key regions are United States, EU, referring essentially to Germany, and Asia, referring essentially to Japan and China. During the last 15 years the US has seen strong growth, asset appreciation, an unstoppable appetite for imports and low national saving, leading to a huge trade deficit. Combined with its role as the provider of world reserves it becomes the natural "keystone" in a global model.

Germany, on the other hand, stands in as the stereotypical contintental European country with comparatively slow domestic demand growth but a strong export performance. Equally important, its saving– and consumption behavior is neither of the reckless US–American kind nor as thrift– and accumulation–oriented as some Asian economies.

The last of the big three, Asia, shows that immense hunger for US–assets on the one hand and export markets on the other, probably seen as necessary insurance against currency speculation and the road to industrialization, respectively.[11] Furthermore, relevant for global adjustment are (1) oil prices and (2) external balances of oil–exporting countries. We do, therefore, include oil–exporting countries explicitly.

We distinguish a traded and a non–traded sector, recognized as highly relevant for trade imbalances at least since Salter (1959). Recently, a series of papers analyse the links and policy implications between the two exchange rates that emerge once a non–traded sector is included, the relative price of either traded goods across countries or traded and non–traded goods within a country.[12] One conclusion is that structure of both production and demand as well as the degree of flexibility of both those sides of the equation are crucial in determining an answer to the overarching question—how strong either a depreciation, or a contraction, would have to be in order to achieve balanced international payments.

In summary, we aggregate the 57 sectors GTAP 6 offers into two, the first containing a number of agricultural products, metals, minerals and chemicals and finally motor vehicles and parts, transport–, electronic– and machinery equipment as well as plain manufactures. The non–traded

[9] The GTAP database is the most comprehensive global trade database and as that has become the gold standard for applied general equilibrium modeling, which obviously is not concerned with asset stocks (or flows, for that matter) and their rates of return. International capital flows are limited to aggregate figures of saving in excess of investment that balance the current account. Much emphasis is laid on tariffs and other policy instruments, which do not play a role in our analysis.

[10] Obviously, it is far from complete. Some regions are aggregate regions, for which no input-output tables exist, but are linear combinations of available, similar regions.

[11] A possible fourth set of countries would aggregate the global south besides those countries of the Asia–block. However, the analysis of global adjustment can be carried out without special attention to the poorest countries—they are simply too small to matter between US, Germany, Japan and then China. Obviously, it is an interesting question how these economically small countries would be affected by a global slowdown, and given past experience it seems everything but far fetched to speculate that recessions in the developing world would be amplified, through the accompanying deflation of commodity markets as well as capital flight to safety. The focus of this exercise, however, besides providing an analysis of current global imbalances, is to suggest an alternative global policy model—so that more complicated questions of "dualities" between the industrial giants of the North and the Prebisch–economies of the South will have to be postponed for future research.

[12] See Frenkel and Taylor (2006), La Marca (2007) and Barbosa-Filho (2006).

sector comprises *all* services, those untradable by design—even though they are increasingly becoming tradable—as well as those that certainly have become tradable, such as business and financial services. The rationale behind this simplifying assumption is that despite the strong concentration of value added in service sectors its share in trade is comparatively miniscule.[13]

In the following paragraphs we discuss the social and global accounting for the three regions in turn, hopefully somewhat consistently making the case for the particular, admittedly "ad hoc," aggregation scheme.

See Figure 15 for the SAM of the "US"–composite region.[14] In line with double entry bookkeeping standards, row– and column totals are equal and entries along a row are valued at the same prices. The first two columns show the cost decomposition of the two activities, production of traded and non–traded goods, corresponding to the material balances along row 1 and 2. Note that imports are accounted for as costs—the underlying assumption being that all imports pass through domestic firms before entering the market. Imports as costs have often been viewed as non–competitive, in contrast to competitive imports that enter domestic product in the material balance as a source of supply. However, as we will discuss in detail below, it is straightforward to introduce substitutability of imports with domestic value added in the cost column. Rows 3 and 4 disaggregate value added by factor and sector. A 48% share of value added is generated by labor in the non–traded sector, compared to only 33% in the EU–region and 39% in Asia. The total value added share in the US non–traded sector is 78%. Similarly, the consumption share of services is 81%, roughly 15 percentage points higher than in Europe and Asia.

Column 3 reports allocation of household expenditures on traded and non–traded product, lump–sum taxes and saving. Note that while value added is disaggregated by factor, households are not—the mapping from two factors to one household rests on the standard macro–assumption that labor as well as capital services are rented to "firms," and the total of factor income (sum of $[3, 9]$ and $[4, 9]$) constitutes the "right–hand–side" of private sector's budget constraint in column 3's total.[15]

The government's revenue stems from lump–sum taxes in $[5, 3]$, and is used to finance expenditures, roughly \$2 trillion in $[2, 4]$, all of which occur in the non–traded sector.[16] As the government

[13] Services and income balance stabilized the US current account throughout the last two decades. The services balance remains in surplus, but decreased by almost one third since 1997, from \$90 billion to \$66 billion, little more than 8% of the balance on current account. The balance on income has turned negative in 2006 for the first time in more than three decades.

[14] The US-profile is obviously defined and dominated by the United States as the issuer of the reserve currency and "consumer of last resort." However, in order not to unnecessarily water down any of the other regions' profiles, we integrate the United States with a small set of other developed countries with at least broadly similar input–output characteristics and current account deficits. Most notably, the United Kingdom has been in the red contrary to other large economies of the EU. Furthermore, Portugal and Spain, both outpacing the core countries in demand growth, and Austria and Luxembourg are European deficit countries allotted to the US-region. Outside of the EU only Australia passes as a developed country with a negative trade balance. All of these countries are primary regions with national input-output tables.

[15] One alternative would be to map from n factors to $m > 1$ households, providing a richer distributional picture. Another would be to account for a business sector, which generates income itself—note that the aforementioned assumption about the distribution of value added to households implies that no surplus is generated, and *domestically* both activities operate under perfect competition.

[16] Government expenditures are around 15% of GDP in the GTAP data, which is certainly too low, even by US

runs a deficit, its saving flow in the public flows of funds (row 6) has to be negative, adding to expenditures as a *use* of funds, and balancing the government's row–column totals. Where does the government draw these funds from? Column 7 itemizes transactions in treasury bills, sales as a source of funds from the government's point of view, cell $[6, 7]$, and purchases as a sink in the private sector's flows of funds. The latter comprise the sum of total private and foreign saving ($[7, 3] + [7, 8]$) and the total of physical and "financial" investment.[17]

Column 5 reports export flows, which appear as a use of funds in the material balance and as sources of funds in the international rows. Rows 10 through 19 account for international trade flows between the three countries. The accounting broadly follows Godley's[18] scheme to arrange SAMs in a multi–country model side by side and "flip" cross–border transactions across SAMs, currency–converted and adding to zero in the SAM that happens to be last in the row.

A touch more unconventional is the accounting of payments flows financing trade deficits and the oil–exporting "row." First, the US as the issuer of the single reserve asset is the epicenter of excess saving, in the sense that it either absorbs all of it, or provides it, or channels it from another surplus region to a deficit region. Whatever happens globally, it happens through the accounts of Wall Street and Treasury bankers. The exorbitant privilege to borrow in its own currency belongs to the single hegemon, despite recent—and so far fairly negligible—shifts in reserve allocation towards the Euro.

The oil region appears essentially as a balance of payments row, the international head of an economy without a rump. As petroleum transactions are commonly conducted in US Dollars, the oil–row's imports (and exports) are quoted in Dollars. In Figure 15, oil–rich countries export ca. $106 billion worth of petroleum products to the United States, appearing in their imported cost structure in cells $[10, 1]$ and $[10, 2]$. The same oil countries import $89 billion from the US. The same trade structure appears in the other two SAMs, leaving the oil region's accounts to be balanced in $[10, 8]$. "Opec" has a considerable current account surplus, and the excess export earnings are channeled to supply funds to the US economy. The size of the domestic economies of Saudi Arabia, Venezuela and other oil exporters is so negligible and undiversified that its relations with the "big three" can be reduced to international trade flows.[19]

The characteristics of the Asia–region are (1) a current account surplus, (2) an undervalued exchange rate either due to a fixed or managed peg or other reasons, and (3), a massive reserve build–up, which brings together countries as diverse as China and Japan. The former pursues an export–led growth strategy, whereas the latter wishes to support the apparent expansion, and therefore aim to maintain competitive exchange rates relative to the US–Dollar. While China officially pegged its exchange rate, it is not really known whether Japan intervenes in foreign

"small government"–standards.

[17] The sign convention on flows of funds is to record sources positive and uses negative.

[18] See Godley and Lavoie (2007b) and Godley and Lavoie (2007a) as well as Taylor (2004) for examples.

[19] Our oil-exporters match three characteristics: (1) large export share of petroleum and related products, (2) a current account surplus, driven by those exports, and (3) an economy heavily reliant on commodity exports with no or little domestically created value added. The list comprises 28 countries, most importantly Russia alongside OPEC–members.

exchange markets if the Yen is pushed upwards. Nevertheless, much has been made out of yen–carry trades. Borrowing low–yield yen to finance higher–yielding US$–denominated assets is believed to contribute to the Japanese capital account deficit. An even more straightforward reason for the yen to be held down in financial markets are yield–seeking asset purchases of the "rich and old" Japanese, which appear to be a lot, and an increasing one, despite the malaise the economy has been in for almost two decades.[20] Both countries accumulated tremendous US–Dollar reserves.

What other countries should be on this list? Malaysia is the only other Asian surplus country besides China that officially pegged its exchange rate, but Figure 20 suggests that other countries, too, successfully reduced exchange rate volatility.[21] The final list comprises Japan, China, South Korea, Malaysia, Taiwan, Singapore, Thailand and Philippines. Figure 17 summarizes the data in a SAM.

The unfortunate task of closing the accounting comes to the EU. While the European Union surplus countries have distinct statistics, it is necessary to include the remaining (developing) countries in one of the regions. The sheer size of the EU makes it most suitable to swallow a number of small deficit countries.[22] As it turns out, on an aggregate level the slew of deficit countries do not drown out Germany and France. See Figure 16 for the SAM.

3 A simple model

In this section we present a simplified version of the complete model, in order to expound its core structure. Accordingly, the exposition here is confined to a one–sector, one–country economy without a government and domestic intermediates, but an open trade account.

Figure 18 lays out a SAM with the relevant accounting for this section. Along the first column costs of domestic firms are decomposed into factor costs and imports, the former the total of wage bill wL and profits rK and the latter imports fX valued at foreign prices in domestic currency eP'. It is straightforward to disaggregate the first column into a multitude of *activities*, as the industries are often referred to in the CGE–literature. Following standard bookkeeping practice, the first column total PX is equal to the first row total, which sums the production of *commodities* across buying agents.

The second column shows expenditures of the households alloting total income Y generated in row 2 to consumption PC of the one good and private saving S. Despite a high level of aggregation distributional aspects can be analyzed.

Investment PI figures in the material balance in row 1 and has to be balanced in the flows of funds–row with total saving, which are the sum of private saving S and foreign saving S_F, the

[20] The archetypal and industrious Japanese saver is endearingly referred to as Mrs Watanabe in the Financial Times, industrious as the whole bunch of them accumulated $12.5 trillion in saving up to date, which are still mostly tied up in low–yielding Yen–assets.

[21] The standard deviation of the four Asian real effective exchange rates shown here decreased markedly, on average 55% when comparing the period before and after the Asian crisis in 1997.

[22] Furthermore, even if the Asian or Oil-exporting regions were to reasonably integrate a long list of countries from Albania to Morocco and Sri Lanka to Zimbabwe, we would argue that it fits the EU better as the passive player amongst the four.

negative of the current account $PE - eP'fX$, ensuring that accounts of the rest of the world are balanced.

Macroeconomic equilibrium is attained when demand is equal to production

$$\frac{w}{P}L + \frac{r}{P}K + \frac{eP'}{P}fX = C + I + E \tag{1}$$

or, alternatively, saving equal investment

$$S + S_F = PI \tag{2}$$

along standard textbook lines.

Costs are the sum of factor and import bill[23]

$$PX = QV + efX, \tag{3}$$

where we normalize the foreign output price $P' = 1$, so that only the exchange rate enters domestic price determination. Q, discussed further below, is the unit price of value added V.

In the short run real value added is proportional to real output, so that from $X = V + fX$

$$V = (1 - f)X. \tag{4}$$

This "Leontief assumption" implies that imports fX trade off against value added, but not domestic intermediates: If f is flexible, imported inputs are competitive, whereas domestic inputs are demanded in fixed proportions. Using this assumption in 3 we can solve for P as a weighted average of Q and e

$$P = (1 - f)Q + fe. \tag{5}$$

f itself is a function of the real exchange rate,

$$f = f_c \left(\frac{e}{P}\right)^{-\sigma}, \tag{6}$$

where f_c is the base–year ratio of imports to sectoral output. $\Delta f = -\sigma(\Delta e - \Delta P)$ in standard fashion. In this one–country version, we set exports analogously, with the opposite sign. In the multi–country version, exports follow from an aggregator function of the import functions from the rest of the world.[24]

Consumption is equal to expenditures after saving $PC = (1 - s)QV$. After substituting 5 and

[23] Note that domestic production X is a composite of domestically produced value V and imports and is therefore higher than in National Income and Product Accounting.

[24] Note that our import specification implies a *direct* trade–off in the cost column vis–a–vis domestic value added via relative goods prices, but not vis–a–vis imports from other sources.

$V = (1-f)X$ real consumption becomes a function of relative prices and output,

$$C = \frac{(1-f)(1-s)Q}{(1-f)Q + fe}X, \tag{7}$$

which becomes a standard Linear Expenditure System in the multi–sector version.

Saving is a function of distribution. From the accounting identity $s_w\Omega + s_\pi\Pi = s$, where $\Omega = \alpha Q^{\theta-1}w^{1-\theta}$ is the wage share and $\Pi = 1-\Omega$, we get $s_w\Omega + s_\pi(1-\Omega)$ and after some rearranging the macroeconomic saving propensity s as

$$s = s_\pi - (s_\pi - s_w)\Omega. \tag{8}$$

As the propensity to spend out of wage income is higher than out of capital income, $\frac{\Delta s[w,r]}{\Delta w} < 0$ as long as $\theta < 1$, a "Kaleckian" assumption commonly confirmed by data.

Output follows from aggregate demand $X = C + I + E$ as

$$X = F[Q,e]\,(I+E)\,, \tag{9}$$

where $F[Q,e] = \frac{fe+(1-f)Q}{fe+(1-f)sQ} > 1$ is the multiplier, decreasing in s and f, the "propensities to leak," and furthermore in e,[25] but increasing in Q—money *can* have real effects, given an elastic supply curve. In the multi–sector version, equation 9 is replaced by a standard Open Leontief system.

The price of value added—the GDP deflator—is conveniently modeled as a CES–unit cost function for value added

$$Q = (\alpha w^{1-\theta} + \beta r^{1-\theta})^{\frac{1}{1-\theta}}, \tag{10}$$

the derivative of which with respect to factor prices provides conditional factor demand functions as

$$\frac{L}{V} = \alpha\left(\frac{w}{Q}\right)^{-\theta} \text{ and} \tag{11a}$$

$$\frac{K}{V} = \beta\left(\frac{r}{Q}\right)^{-\theta}, \tag{11b}$$

which implies a trade–off between employment and real wages that is often disregarded as inferior to some Phillips–curve, which posits a positive relationship between nominal wages (and possibly prices) to employment due to improving collective bargaining at higher levels of activity. While principally "bargaining" would be preferred, here we stick to this blatantly classical assumption because it provides a dampening feedback effect which supports overall stability. Secondly, Shephard's Lemma facilitates switching between a General Theory type–Keynesian labor market and a neoclassical full employment model. Moreover, deriving conditional demand functions from CES–aggregations is probably the single most important exercise in standard CGE–models, and even

[25] We define the exchange rate as the price of a unit of foreign currency in terms of domestic currency, meaning a devaluation has a negative effect on the multiplier.

though output and import demands do not rest on optimizing "first principles" it grants us a degree of comparability to the relevant mainstream policy models.[26]

Dual to the cost function for a unit of GDP is a CES–production function that relatively smoothly combines labor and capital. If labor supply is elastic, an exogenous and positive shock to demand (from exports or investment) would increase employment and GDP.[27]

How do we solve the model? The money wage is set institutionally, but employment is an inverse function of the real wage.[28] The "bargained" wage w^* serves as model numeraire, indicated by the star. *Real* investment is subject to entrepreneur's "animal spirits," and as such exogenous to the model.[29] The profit rate is endogenous. Solving K's Shephard's Lemma (equation 11b) for r determines the profit rate with diminishing returns to capital as

$$r = Q\left(\frac{\beta(1-f)X}{\overline{K}}\right)^{\frac{1}{\theta}}. \tag{12}$$

Given w^*, we can express Q as a function of the wage rate and output, with $\frac{\Delta Q}{\Delta w^*} > 0$ and $\frac{\Delta Q}{\Delta X} > 0$. The profit rate can as well be expressed as a function of the exogenous wage rate and output, $r[w^*, X]$. The Keynesian assumption of under–employment implies that it is possible that profit rate and real wage are positively correlated, $\frac{\Delta r}{\Delta w^*} > 0$, reflecting an an economy *within* rather than *on* the factor–price frontier.

In this Keynesian "closure" output adjusts, given prices, in order to attain equilibrium. Consumption follows the level of income. Increasing investment or higher export demand are the means to an expansion. *Decreasing* import or saving propensities would provide at least short–term gains. Lowering nominal wages would lead to a *smaller* decrease in the price level Q, in turn decreasing real wages and thus allowing for employment increases, but the deflationary effect might very well induce real apprecation and consequential adverse demand effects. In fact, how the external balance is determined is crucial for overall adjustment.

Suppose the exchange rate is exogenous and trade flows respond freely to relative price changes. The current account then is a function of the real exchange rate,

$$CA = PE[\frac{e}{P}] - ef[\frac{e}{P}]X, \tag{13}$$

and the question typically asked is whether a depreciation leads to an improvement in the balance

[26] Despite this list of "advantages," the model should be extended to allow for a more realistic factor market specification with a positive link between real wages and productivity on the one hand and productivity and output on the other. See Foley and Taylor (2006), Naastepad (2006) and Rada (2007) for examples of such models.

[27] If labor is fully employed, on the other hand, a demand shock would crowd out consumption. In that case, the model becomes supply–constrained without modeling production– or transformation functions as is standard practice in CGE–modeling.

[28] See equation 11a above. Neoclassical marginal factor price determination is solved for L.

[29] Keynes argues in chapter 12 of the General Theory (Keynes (1936)) that investment is driven by "long–term expectations," rather than interest rates or demand, which leads to the handy concurrence of elusive entrepreneurs' decisions and a modelers ideas.

of payments. The total derivative of CA with respect to the exchange rate is

$$\frac{\Delta CA}{\Delta e} = -fX + P\frac{\Delta E}{\Delta e} + E\frac{\Delta P}{\Delta e} - e\frac{\Delta f}{\Delta e}X - ef\frac{\Delta X}{\Delta e}, \tag{14}$$

where one can derive the specific Marshall–Lerner conditions. Similarly, one can derive effects of a devaluation on output and income distribution. In a more complete model, the government's balance is likely to be affected, an issue we will take up further below.[30]

The alternative external "closure" would be to fix the current account at its base–year level or a level targeted by policymakers. The nominal exchange rate e then becomes the variable that equilibrates demand–driven trade flows and a set trade balance,

$$e = e[fX, PE, \overline{CA}]. \tag{15}$$

The full version of the model differs primarily with regard to sectoral classification. As discussed in the previous section, we aggregate data into a three–region, two–sector set of traded and non–traded product. With two sectors the degree of factor mobility is relevant for the specification of factor markets. We choose to model capital as perfectly immobile in the short run, applying Shephard's Lemma—equation 12 above—on sectoral capital stocks. Labor, on the contrary, is designed as *either* perfectly mobile—sectoral L_i on a uniform wage rate w—or perfectly immobile.[31]

Obviously, the complete model features intermediates and a government. The latter is conceived to borrow and lend just as much as necessary in order to finance its expenditures, a quite realistic assumption at least in the short run all too often forgotten by CGE–modelers.

Finally, a three region model features three bilateral exchange rates, only two of which are determined within the model. e_{12}, the US/EU–rate, and e_{13}, the US/AS–rate, are either policy variables and determine levels of current accounts (equation 13) or are endogenous themselves from equation 15. e_{23}, the EU/AS–exchange rate, in either case follows as the ratio $\frac{e_{13}}{e_{12}}$.

The baseline causal configuration ("closure") can be summarized first as

$$r_{ci} = r[X_{ci}; \overline{K_{ci}}] \text{ and} \tag{16}$$

$$L_{ci} = L_{ci}[X_{ci}; w_c^*], \tag{17}$$

for factor markets, where $c = US, EU, AS$ is the index of countries and $i = T, NT$ the index of

[30] The literature in this field is vast. See Krugman and Taylor (1978), Machlup (1955) as well as Johnson and Caves (1968) for discussions of elasticities–, absorption– and "synthesis"–approaches to devaluation effects on balance of payments and domestic activity. Note that this literature, in accord with policies in the first three postwar decades, assumes the exchange rate to be fixed, which makes such exercises particularly important.

[31] A real depreciation shifts production towards tradables and consumption towards non-tradables. Hence, the more flexible labor markets, the smoother transition, and the smaller the real depreciation necessary for adjustment. In this paper, we focus on the Keynesian labor market closure where labor supply responds flexibly to any production shift.

1-L-X-CA[1,2,3]

Shock:	w[1]	1.3	30%				
Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	22.8%	4.9%	3.4%	**Current Account (in $)**	-49.3%	119.5%	34.3%
GDP Deflator	26.2%	3.5%	2.5%	**Government Deficit**	-41.9%	10.5%	6.5%
Real Wage	3.0%	-3.4%	-2.4%	**Value Added**	-4.2%	3.5%	2.9%
Nominal Exchange Rate	0.0%	0.0%	0.0%	**Labor Demand**	-6.7%	6.8%	5.1%
Relative traded prices	-9.9%	2.6%	2.5%	**Wage Share**	0.3%	29.6%	-0.4%
Traded/NT-price ratio	-5.0%	2.2%	2.2%				

Figure 1: Simulation results: Rates of growth of selected aggregated variables after a 30% shock to US nominal wage rate. Closure 1–L–X–CA[1,2,3]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; three endogenous current accounts. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

sectors. A bar defines a variable as exogenous and w_c^* are the three numeraire wages. Secondly,

$$CA_c = -S_c^F = CA[X_{ci}; e], \tag{18}$$

$$\sum_i P_{ci}\overline{I_{ci}} = S_c[X_{ci}; \Omega_c] + S_c^G + S_c^F \text{ where} \tag{19}$$

$$S_c^G = Y_c^G - P_{c2}\overline{G_c}, \tag{20}$$

closes the flows of funds of government and private sector. As is easily verified, X_{ci} are the accomodating variables: Quantity changes are not only possible, but in fact take center stage.

In the next section we discuss a few preliminary simulations in order to delineate the key mechanisms of the model.

4 How the model works

4.1 Wage shocks: Assume collective bargaining ...

How does a shock to wages affect equilibrium? Suppose US unions were successful in bargaining nominal wage increases that finally provide some catch–up towards productivity gains made during the last decade. We begin by investigating the baseline closure, with a uniform wage in Keynesian labor markets, output adjustment in the macro–balance and all three current accounts endogenous, following set exchange rates. Since wage(s) anchor the price system(s) in this Keynesian model, it makes sense to examine its impact in a little more detail.

A shock to the equalized wage rate (equation 11a above) in the US' two sectors stirs inflation,

initially in the GDP–deflator, which then feeds into output prices. See Figure 1 for an overview of the simulation results. In this and all other tables showing simulation results, output prices and GDP deflators are Fisher price indexes (geometric averages of Laspeyres and Paasche price indexes). The real wage is a simple average. The nominal exchange rates are $e[1,2]$, the US/EU–rate, $e[1,3]$, the US/AS–rate, and $e[2,3]$, the EU/AS–rate, read from left to right. The real exchange rate is the ratio of a weighted average of foreign traded prices in domestic currency and domestic traded goods prices. Statistics of current account and government deficit are stated such that a positive growth rate implies an improvement—a reduction in the trade deficit, an increase in a surplus, and analogous for the government's balance.

With fixed capital stocks and sufficient price increases, nominal profit rates *increase*, but fall in real terms. The shock permeates through the price system as $\Delta w > \Delta Q > \Delta P > \Delta r > \Delta(\frac{w}{Q}) > 0 > \Delta(\frac{r}{Q})$. The rise in the nominal wage is stronger than the rise in the GDP–deflator, so that the following real wage increase leads to a fall in employment and a commensurate rise in induced labor–saving productivity. Sectoral capital stocks, on the other hand, are assumed fixed in the short run, and following a contraction in real value added see a drop–off in productivity.

Where does the fall in real value added originate from? Obviously, the fall in employment from marginal factor pricing implicitly leads to a decrease in GDP via the dual production function in L and K, but is explicitly accounted for by the "Leontief assumption" discussed above. Real value added is proportional to output X—and output X contracts due to a drop in export demand following relative price changes.

The wage shock in the US leads directly to output price increases, while abroad, the same output price increases trigger imported inflation, which, however, are smaller in magnitude than domestic inflation. With fixed nominal exchange rates, the inflation differential translates fully into real appreciation, increasing global demand for traded foreign goods—Asian as well as European—and decreasing global demand for US traded goods. Thus, relative price changes lead to changes in demand, which subsequently change employment patterns through Shephard's Lemma.

How does this story change in a modified closure? Suppose the nominal Dollar–Euro exchange rate is endogenous rather than set by policy, a quite plausible assumption given both the lack of an exchange rate policy from the Fed or the ECB and the liquidity in these two markets. Suppose furthermore that Asian foreign savings—the region's demand for US reserve assets—are policy variable, an assumption that may be justified on the face of the incredible reserve accumulation of Japanese, South Korean and above all Chinese monetary authorities.[32]

See Figure 2. The nominal wage shock in the US—still uniformly applied to both sectors—increases costs domestically and leads to increases of demand for, primarily, EU goods. Higher costs trigger a strong real appreciation, as the domestic price level increases relative to foreign prices in domestic currency, and traded goods prices fall relative to non–traded goods prices. The bilateral exchange rate between the US and Asia–region, however, remains pegged, and nominal

[32] As discussed in a previous section, our model specification implies that exchange rates are set from the side of trade. Nevertheless, it makes sense to look at shocks to foreign saving flows from the financial side—which then drives trade, in turn setting the exchange rate.

1-L-X-CA[1,2]

Shock:	w[1]	1.3	30%				
Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	17.6%	14.7%	-0.6%	**Current Account (in $)**	-61.4%	228.3%	0.0%
GDP Deflator	23.5%	10.1%	-0.2%	**Government Deficit**	-49.6%	30.3%	0.2%
Real Wage	5.3%	-9.1%	0.2%	**Value Added**	-7.2%	9.9%	-0.2%
Nominal Exchange Rate	-26.5%	0.0%	36.1%	**Labor Demand**	-11.4%	20.0%	-0.3%
Relative traded prices	-16.0%	9.1%	2.5%	**Wage Share**	0.5%	28.9%	0.0%
Traded/NT-price ratio	-8.9%	6.4%	-0.5%				

Figure 2: Simulation results: Rates of growth of selected aggregated variables after a 30% shock to US nominal wage rate. Closure 1–L–X–CA[1,2]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; two endogenous current accounts, e[1,3] exogenous. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

adjustment is borne out by the Dollar–Euro rate. The Euro–Asia rate, in turn, follows directly as the ratio of the policy rate (US/AS) and the endogenous rate (US/EU),[33] implying a commensurate devaluation of the European currency vis–a–vis Asia. Thus, if Asia successfully maintains its peg by accumulating Dollar reserves, eroding cost competitiveness from nominal wage increases in the US has to lead to a nominal appreciation relative to the EU, where (1) increased import costs lead to output price increases, (2) a fall in export prices (in foreign currency) increases demand for domestic product, increasing value added, Q, subsequently lowering the real wage and increasing employment.

4.2 Foreign saving shocks

How does a shock to foreign lending permeate through the system? How would a decline in European or Asian demand for Dollar–denominated assets play out, and what adjustments are necessary to decrease the US current account deficit? Such questions can be answered in this framework by first endogenizing one or two exchange rates and secondly fixing international payments flows. Obviously, a "financial" interpretation of a contraction of, say, the EU trade surplus with the US as a decline in demand for US assets requires some goodwill, but because we are not modeling the financial side of the economy explicitly the capital account is fully subsumed in foreign saving flows mirroring trade. If that seems too big a leap, the reader might adhere to the mechanistic counterfactual asking what changes are necessary to bring about a "halving of current accounts."

We discuss first a Keynesian closure, meaning macro–balance is investment–driven with output

[33] The whole system is linked by only two exchange rates, the third bilateral exchange rate is $e_{23} = \frac{e_{13}}{e_{12}}$.

1-L-X-CA[1]

Shock:	CA[2]	60.2	-50%

Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	2.2%	-3.0%	-0.3%	**Current Account (in $)**	9.3%	-43.4%	6.8%
GDP Deflator	1.3%	-1.9%	-0.1%	**Government Deficit**	5.1%	-3.9%	0.1%
Real Wage	-1.2%	1.9%	0.1%	**Value Added**	1.8%	-1.9%	-0.1%
Nominal Exchange Rate	13.2%	6.8%	-5.7%	**Labor Demand**	3.0%	-3.6%	-0.2%
Relative traded prices	3.6%	-2.3%	-1.3%	**Wage Share**	-0.1%	0.2%	0.0%
Traded/NT-price ratio	1.7%	-1.5%	-0.2%				

Figure 3: Simulation results: Rates of growth of selected aggregated variables after a –50% shock to the EU current account. Closure 1–L–X–CA[1]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; US current account and e[1,2] as well as e[1,3] endogenous. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

adjustment and labor markets allow for underemployment. Based on these domestic configurations we investigate several possible international closures. To get started, suppose exchange rates between US and EU and US and Asia are endogenous, with the third bilateral exchange rate following directly therefrom. Then two foreign saving levels can be fixed, and shocked. Suppose the US deficit follows from the "policies" run in Europe and Asia, leaving CA_{US} endogenous and CA_{EU} and CA_{AS} fixed.

Reducing the European surplus by 50% (in Euro) leads to a strong nominal appreciation of the Euro against both other currencies. See Figure 3. Balancing trade at this new level requires a redirection of international flows of goods, which comes about given changes in relative prices. In the US, the depreciation against the Euro increases import prices, inflating US output prices, while the appreciation of the Euro decreases import prices, deflating EU output prices. First, substitution is imperfect, and secondly pass–through is limited, so that domestic price changes—positive or negative—are smaller than the nominal exchange rate changes. US inflation and EU deflation therefore imply a real depreciation and real appreciation of currency, respectively, when measured as foreign output price indices in domestic currency relative to domestic price indices.

Furthermore, price changes are stronger—positive or negative—in the traded sector than in the non–traded sector. The causal chain, if one dares to set up such a thing in a system of simultaneously solved equations, starts at the equilibrating variable output, which rises with increasing export demand in US, and falls with decreasing export demand in EU. Higher X in turn implies rising value added V, pulling up rates of profit on given amounts of machinery running on full capacity, leading to a rise in the general price level Q. The increase of output in the tradable sector leads to a *smaller* increase in output in non–tradables through intermediate demand, somewhat propping

up profits and prices there. Thus, in the US, the tradable output price increase is larger than non–tradable output price increase, combining to a real depreciation in that price ratio as well. Real consumption shifts towards the sector with less inflation, while real value added shifts towards tradables. Vice versa in the EU: $\Delta P_T < \Delta P_N < 0$, and consequently $\Delta V_T < \Delta V_N < 0$ and $\Delta C_T > 0 > \Delta C_N$.

What are the implications of the changing price–, consumption– and production patterns for employment? As mentioned in the preceding paragraph, marginal factor pricing determines rates of profit on given capital, which rise (fall) with an increase (decrease) of output in the respective sector, consequently increasing (decreasing) Q, the price of a unit of value added. Such changes in the GDP–deflator drive real wage changes, which prompt commensurate labor demand changes: Labor demand rises in the US, falls in the EU, and does so more pronounced in the traded sector in both regions.

What is going on in Asia, in the meantime? In this particular international closure, Asian net foreign lending is fixed at the base–year level (in local currency), and the Asian exchange rate floats freely against both Dollar and Euro. The major changes certainly occur between US and EU, as it is the former the latter has a surplus with, but the changes in international prices nevertheless reverberate through Asia. Along with the nominal depreciation of the Dollar against the Euro the Dollar depreciates against the Asian currency—in this specific simulation $\Delta e_{12} = 13\%$ and $\Delta e_{13} = 7\%$. This nominal appreciaton of Asian currency, however, is balanced by the appreciation of the Euro against it. The particular combination of base–year import propensities, trade elasticities and exchange rate changes leads to insignificant deflation in Asia, and overall real appreciation. Real appreciation softens export demand, which decreases output in the traded sector *more strongly* than in the non–traded sector, with the same aggregate result of a fall in GDP and employment.

4.3 Sitting in the drivers' seat: The key mechanisms

Let's try to dissect the mechanisms at the heart of the model.

First, costs of inputs, capital and labor determine output prices. Demand responds to changes in prices, but has no direct effect upon them. Such a price conception persists in economics since its foundations were laid by Adam Smith, who argued that prices were fundamentally determined by costs, which even for machinery and material inputs might be traced back to the labor necessary to produce them. Keynes as well as Kalecki subscribed to such price formation. That the model features decreasing returns, instead of arguably more fashionable positive feedbacks appears to be a side issue at least with regard to the determination of output prices. We turn Kalecki's stable mark–up on costs or a classical component of costs paid to rentiers into a variable rate of return on capital that rises with activity and the general price level. It is critical to see the implications of this configuration. On the one hand, prices are cost–driven in classical or Post–Keynesian fashion, firmly situating the model outside of smooth, marginalist supply– and demand–equilibration. On the other hand, factor markets, and implicitly production, are neoclassical with decreasing returns to scale and some substitution between labor and capital.

Secondly, the model is demand–driven. Keynes argued that output in the short run is determined by the multiplier on investment, and Harrod and Thirlwall and others extended this line of reasoning to exports. Thus, each region's economic performance depends on investment and export demand, the former exogenous and the latter proportional to (global) production but furthermore dependent on relative prices. Ceteris paribus, only a real depreciation increases real output! The demand increase props up profits, raising the general price level, which decreases the real wage, in turn leading to higher employment and value added. Crucially, demand–determined output X is the adjusting variable in macro–balances, acting as the link between international price changes and domestic production– and consumption shifts.

Third, those expenditure– as well as production shifts are crucial for adjustment. It has long been recognized that balance of payments adjustment requires not only expenditure reduction but furthermore an expenditure shift. Real appreciation increases non–traded goods prices, so that consumption shifts towards traded goods, whereas production shifts towards non–traded goods.

Fourth, the law of one price does not hold. International goods arbitrage does not lead to price equalization across borders, because domestic output prices are largely determined by factor costs—which is the case whether factor markets are competitive or not. If prices are determined from the input and factor cost side, the given base–year data determines the degree to which import price changes can pass through to output prices, and that pass–through is limited by design, making competition between traded goods producers imperfect. Partial pass–through, in turn, is the driving force behind inflation *differentials* across countries, and thus determines real exchange rate changes.

Fifth, holding foreign saving flows constant "easily" reflates economies. In the end, some variables always have to be exogenous, and in external accounts it is usually a foreign saving flow that is fixed at its base–year level,[34] which is then reached, but not surpassed, by the trade flows of the chosen country. As we will see in more detail below, such practice has quite important consequences once the model under this closure is adversely shocked. An investment contraction, for example, has a (global) deflationary impact—which cannot play itself out to full extent as long as the level of trade of one country is held at a high, base–year level.

In summary, real wages and real exchange rates are the driving prices of the model. The adjusting variable, however, is output X, an assumption built in the model in accordance with the overwhelming evidence that Keynes assumption of excess capacity and quantity adjustment in the short run was right. Does such a model live up to explain the explosion of global imbalances during the last few years? In the following sections, we take up that question.

[34] In our neoclassical version of the model, which we do not discuss in detail here, we fix a foreign saving flow as the numeraire of the model. In a full–employment model with a vertical supply curve and all foreign savings flows fixed, these nominal effects on real activity are ruled out.

1-L-X-CA[1,2,3]

Shock:	P[4, 1]	1.5	50%

Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	0.4%	0.6%	0.8%	**Current Account (in $)**	-5.0%	-28.0%	-10.9%
GDP Deflator	-0.1%	-0.2%	-0.2%	**Government Deficit**	-2.0%	-3.3%	-2.8%
Real Wage	0.1%	0.2%	0.2%	**Value Added**	-0.1%	-0.2%	-0.3%
Nominal Exchange Rate	0.0%	0.0%	0.0%	**Labor Demand**	-0.2%	-0.3%	-0.5%
Relative traded prices	2.2%	2.0%	4.2%	**Wage Share**	0.0%	0.0%	0.0%
Traded/NT-price ratio	0.7%	0.6%	1.0%				

Figure 4: Simulation results: Rates of growth of selected aggregated variables after a 50% shock to oil prices. Closure 1–L–X–CA[1,2,3]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; and three endogenous current accounts. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

5 Back to the future

5.1 Oil price shocks and Asian exuberance

Since 2001—the base–year of GTAP 6—a host of global macro–, trade– and finance–indicators has broken records. In fact, global imbalances became absurdly huge only after 2001. The total deficit almost doubled in size from about $430 billion in 2001 to $835 billion in 2006, with Chinese bilateral net exports figuring in prominently at $230 billion.

The mounting trade deficits, however, are only part of the story. Oil prices have risen dramatically since the beginning of this millenium, an amazing 181% from a low of $13 per barrel in 1998 to an average of $64 per barrel in 2006.[35] Oil imports figure prominently amongst major components of the trade deficits, its share in total imports grew from a meager 6% to 16% between 1998 and 2006, and still showed more than 50% growth between 2001 and past year.

As mentioned before, demand for Dollar–denominated assets picked up strongly during this decade, first led by a stock market recovery, and possibly the productivity differential, making US corporations prime targets for foreign direct investment, primarily M&A–activity. Soon, though, central banks stepped up their efforts. Between 1998 and 2002, Dollar reserve accumulation had already doubled from a level of $200 billion, but doubled again to almost $850 billion in 2006. Similarly, China, South Korea, Malaysia, Singapore and Taiwan as well as Hong Kong listed high on the list of treasury hunters, the latter two possibly as agents of still higher Chinese demand.

It seems judicious to investigate how the model(s) with their different causal structures respond

[35] The statistics are weighted averages of major petroleum types as reported by Unctad's commodity price bulletin.

to a combination of shocks that summarizes these two catalysts as an increase in oil prices and a policy–led increase in Asian net lending to the US.

Taking a first look at oil price shocks in the baseline model, with investment–driven macro–adjustment, underemployment of labor and trade flows adjusting to incomes, we see that international adjustment differs from the response to changes in any of the major economies. The particular treatment of the oil region as "disembodied" without domestic production and currency, whose exports are quoted in US Dollars, generates a real *contractionary* depreciation in all of the three economies. The increase in energy import costs, exacerbated by low price elasticities, leads to inflation, but because Saudi Arabia does not begin to import ever more luxury goods,[36] none of the regions experiences appreciation any of the inflating countries were able to exploit. See Figure 4.

In a second step, fixing the Asia–US bilateral current account at the base–year gives a degree of freedom that can be used to endogenize the Dollar–Euro exchange rate. As the Euro–Asia exchange rate follows as the ratio of US/Asia and US/EU–exchanges, only one bilateral rate is policy determined, namely the price of a Dollar in terms of Yen, Renminbi and Won. A higher oil price then inflates the US and Asia, the latter of which is—by design—able to maintain its external position. Maintaining export shares is possible only with real depreciation, which in turn requires a sizable *nominal* depreciation if output prices are rising domestically and abroad due to increased oil bills. Thus, nominal appreciation of the Euro against both other currencies actually deflates the European block. In standard fashion, the export demand boost raises value added, raising profits and labor demand. See Figure 5.

Evidently, Asia benefits mainly from its "directed" capital inflows, which, fixed at the base–year level, represent a form of demand management policy in the face of a negative cost shock. The same holds true in other model configurations. The country with (high) exogenous US lending benefits most, at the expense of the other two countries. The steady flow of net foreign assets leads to undervaluation of domestic currency, laying the foundation for export–led expansion. A real side full employment model does not allow for such a move and would appear less suitable for analysis of a world in which monetary factors are so crucial.

Now, how does an oil price shock combine with *increases* in US net foreign borrowing? We approximate, first, by simulating a 50% shock to Asian and European foreign lending (in local currency), on top of the oil price shock of 50%. To come near the global economy of the last six years, however, we secondly have to shock US domestic demand levels. What happened would maybe be better described as foreign lending channeled to households in order to finance consumption, but we simplify strong demand growth as a 20% real investment shock—not entirely random given recent residential investment rates.[37]

Figure 6 shows the "goldilocks" we were looking for in terms of growth. Expansion in EU as

[36] We assume exports from the three main regions to the oil–exporters fixed in real terms.

[37] By shocking investment rather than consumption we avoid meddling with the Linear Expenditure system that determines consumption. For all practical purposes, it does not matter a lot. (It would, if the model were stock–flow consistent.)

1-L-X-CA[1,2]

Shock: P[4,1] 50%

Price variables	US	EU	AS
Output price	1.8%	-2.2%	2.1%
GDP Deflator	0.7%	-2.0%	0.6%
Real Wage	-0.7%	2.0%	-0.6%
Nominal Exchange Rate	10.4%	0.0%	-9.4%
Relative traded prices	4.6%	-0.3%	4.1%
Traded/NT-price ratio	1.8%	-0.8%	1.8%

Quantity variables	US	EU	AS
Current Account (in $)	0.8%	-71.9%	0.0%
Government Deficit	1.3%	-6.9%	-0.8%
Value Added	1.0%	-2.0%	0.7%
Labor Demand	1.7%	-3.7%	1.2%
Wage Share	-0.1%	0.2%	-0.1%

Figure 5: Simulation results: Rates of growth of selected aggregated variables after a 50% shock to oil prices. Closure 1–L–X–CA[1,2]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; and two endogenous current accounts. The US/EU–exchange rate is endogenized. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

well as Asia is export–led, but domestic and debt–led in the US. Strong output growth primarily in the US and Asia and large trade surpluses abroad match the record, and relative price changes fit the *pre–2002* picture with a real appreciation in the US, and real depreciation in EU and Asia.

5.2 Savings glut or US indulgence?

The preceding section focused on reserve accumulation in Asia and strong asset demand from Europe as prime movers of US trade imbalances, an idea in line with Bernanke's global saving glut hypothesis. According to this view, excess saving—even above the enormous domestic investment levels in China—are channeled to the US, where the deepest financial market offers both security and returns.

An alternative hypothesis is that the US pulls in funds—and given the size of the capital outflows one might argue it happens with a giant sucking sound—because nobody in the US is saving. Both households and government are running quite large deficits, adding to already high debt levels. As briefly discussed in the introduction, Barbosa-Filho et al. (2007) conducted an empirical lead–lag–analysis of comovements of net borrowing flows by major economic actors, and find that strong growth in personal income and consumption are highly correlated and lead the external deficit for the last two and a half decades. At the same time, the rate of saving out of personal income decreased substantially—after depreciation it has been, in fact, negative for a while.

Obviously, some of these shifts are fairly *long–term* structural changes, but certainly the shift towards wealth– and debt–financed consumption was exacerbated by a combination of financial

1-L-X-CA[1]

Shock: P[4, 1], Inv[US], CA[2], CA[3]

Price variables

	US	EU	AS
Output price	3.6%	2.6%	7.5%
GDP Deflator	4.3%	1.7%	4.3%
Real Wage	-4.2%	-1.7%	-4.1%
Nominal Exchange Rate	-3.8%	-16.3%	-13.0%
Relative traded prices	-2.6%	1.8%	8.2%
Traded/NT-price ratio	-1.4%	1.4%	5.2%

Quantity variables

	US	EU	AS
Current Account (in $)	-49.9%	44.3%	25.6%
Government Deficit	26.1%	4.2%	8.6%
Value Added	6.3%	1.7%	4.9%
Labor Demand	10.5%	3.3%	8.7%
Wage Share	-0.4%	-0.1%	-0.7%

Figure 6: Simulation results: Rates of growth of selected aggregated variables after a combined shock of 50% to oil prices, 50% to CA[3] and CA[2] in local currency and 20% to US real investment levels. Closure 1–L–X–CA[1]: Uniform wages across sectors in Keynesian labor markets; investment–driven output adjustment; and US' current account endogenous. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

factors at the beginning of this decade—specifically, low interest rates and financial innovation. Then, a fairly straightforward way to match the resulting pattern of demand changes is to shock private saving on the one hand, and investment, particularly of the residential kind, in the US.

Solely shocking private saving in the US has, of course, global inflationary effects. The paradox of thrift is here in full effect: US' multipliers increase with lower saving, and output X rises across regions, strongest domestically. The demand increase pulls up nominal profit rates, which feed into prices of value added and outputs, in turn leading to *smaller* inflation in the other two regions through import price increases. The resulting real depreciation of European and Asian currency triggers export increases, predominantly to the US. In the simulation—with two policy–set bilateral exchange rates—the EU current account almost triples.

A more realistic closure with an endogenous US/EU–exchange rate, and set Asian net foreign lending, combined with investment demand increases moves us in the right direction with a strong real value added expansion of 9% in the US, more moderate growth in the EU, and the expected changes in trade balances.[38] However, two pieces of the puzzle are still missing, first, the tremendous growth in Asian net exports, and secondly, the increase in oil prices.

See Figure 7 for details of this simulation. To interpret these results it is important to see how shocking Asian net foreign lending "creates a bubble"—the increase in this nominal variable inflates the whole system, and oil prices do further. These changes in output prices—driving trade flow changes—are heightened by changes in factor prices, as the mechanics of the model effect the expansion through rising profit rates, which depress the real wage and make higher factor usage

[38] There is no table corresponding to this result and the preceding paragraph.

1-L-X-CA[1,2]

Shock: Inv[US], S[1], P[4,1], CA[3]

Price variables	US	EU	AS
Output price	19.0%	8.9%	7.4%
GDP Deflator	20.1%	7.2%	5.3%
Real Wage	-16.7%	-6.7%	-5.0%
Nominal Exchange Rate	0.9%	0.0%	-0.9%
Relative traded prices	-2.7%	2.4%	5.3%
Traded/NT-price ratio	-2.7%	3.6%	4.6%

Quantity variables	US	EU	AS
Current Account (in $)	-149.5%	288.8%	75.0%
Government Deficit	137.1%	26.6%	14.3%
Value Added	29.6%	7.1%	6.1%
Labor Demand	52.9%	14.1%	10.9%
Wage Share	-1.8%	-0.6%	-0.8%

Figure 7: Simulation results: Rates of growth of selected aggregated variables after a combined shock to US–saving (negative), US–investment, Asian net foreign lending and oil prices (positive). Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

possible. Higher profits, of course, come from output increases, which are *highest* in the US due to the consumption binge following the increase in multipliers. (As might be expected, the argument seems circular.) Key is: All three regions join in the goldilocks revelry, and opposed to received wisdom the "global saving" glut is certainly not the only possible explanation for the explosion of imbalances throughout recent years.

In the next section, we begin thinking about how adjustment might take place.[39]

6 Looking forward?

6.1 Revaluing Yen and Renminbi

During May of this year the US administration felt compelled to ensure financial markets that the Dollar–Yen exchange rate is determined by capital flows, is not undervalued and that there is no need to pursue a revaluation. Still, some observers doubt that Japanese authorities are altogether innocent, and surging levels of the bilateral current account might support such a view.[40] Moreover, Japan is one of the leading geese—besides China, Taiwan and South Korea—of Dollar reserve accumulators. The exact amount of Dollar reserves is a statistic notoriously difficult to pin down,[41]

[39] Ideally, the next section should be based on a SAM that results from either this or the preceding section, so that we "iterate"—from the base year 2001 to today, and then towards adjustment. Due to time and space constraints, the exercise has to be postponed for future research. It is worth keeping in the back of one's mind that necessary price– as well as quantity changes might be *larger* because the imbalances are in fact *larger* today than in the 2001 data.

[40] The bilateral current account hit a record high in May, even though more than half of payment flows are due to (Toyota's) income surplus, and not merchandise trade.

[41] Brad Setser and blogging colleagues have gained some fame in tracking Asian purchases of Dollar reserves.

1-L-X-CA[1,2,3]

Shock:	e[1, 3]	1.2	20%

Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	1.2%	1.6%	-4.9%	**Current Account (in $)**	5.1%	32.2%	-20.4%
GDP Deflator	0.7%	1.1%	-3.0%	**Government Deficit**	2.8%	2.6%	-5.8%
Real Wage	-0.7%	-1.1%	3.1%	**Value Added**	1.0%	1.1%	-3.5%
Nominal Exchange Rate	0.0%	20.0%	20.0%	**Labor Demand**	1.7%	2.1%	-5.9%
Relative traded prices	2.1%	1.1%	-3.8%	**Wage Share**	-0.1%	-0.1%	0.5%
Traded/NT-price ratio	1.0%	0.8%	-3.5%				

Figure 8: Simulation results: Rates of growth of selected aggregated variables after a policy–induced 20% nominal revaluation of Asian currency vis–a–vis the US Dollar. Closure 1–L–X–CA[1,2,3]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

but as a ballpark number sufficient for our purposes we can look at total official reserves reported by the IMF (International Financial Statistics) and assume that roughly 75% of that amount is held in US treasuries. Japan comes out with roughly $700 billion, surpassed only by China, famously breaking the trillion Dollar mark in reserve accumulation late in 2006. Japan's holdings of reserves quadrupled during the last eight years, again only outdone by China, whose holdings increased more than seven–fold during the same time period.

It certainly seems as if somebody is dumping local currency, recycles Dollar–export revenues, tries to combat currency appreciation, to mop up excess liquidity and to insure against more or less sudden capital flight, or any combination thereof. Whether or not the Japanese administration is publicly scolded by its US counterpart just as the Chinese People's Bank becomes a minor matter. Reminding the latter of the need for a Renminbi revaluation, on the other hand, is one of US' economic officials' favorite pastime. Soon after taking office, the head of the Treasury, Hank Paulson, announced a top–level "Strategic Economic Dialogue," which has indeed resulted in a widening of the trading band the Renminbi is allowed to fluctuate within on a daily basis, first to 0.3% and more recently to a whopping 0.5%. The resulting nominal appreciation of the renminbi from the hard peg of 8.28 CNY per US Dollar, at which the currency was held between the 2nd quarter of 1995 and the 2nd quarter of 2005, to 7.86 CNY per US Dollar in the last quarter of 2006 presents a miniscule step in the desired direction, from Paulson's point of view.[42]

How would further guided appreciation of the Renminbi–Dollar rate affect global imbalances? Let's begin again with the baseline model, completed by three endogenous trade accounts, and shocked by a policy induced nominal Renminbi–depreciation of 20% against both Dollar and Euro.

[42] See Figure 21 for a plot of the time series.

See Figure 8 for details.

The nominal depreciation imports inflation in US and Europe, and imports deflation in Asia. The latter effect is larger than the former because the Dollar price of a Euro has not changed and only the Asian set of imports in the other two regions come with a higher bill. The inflation differential and the nominal exchange rate shock are just sufficient to produce 2% and 1% real depreciation in the US and EU, respectively, compared to 4% real appreciation in Asia. The rest is business as usual. Increasing export demand in the two "Western" regions increases output and value added, raising profits and prices, which in turn decrease real wages, triggering positive employment changes, all of which are more pronounced in the traded sector. As export demand contracts in Asia, the reverse with all its negative effects takes place there. If this picture drawn in Figure 8 is considered a good description of reality it might be one reason why China is hesitant to subscribe to a revaluation.

Then again, changing closures changes any story. Endogenizing the Euro–Dollar rate and holding Asian net US lending fixed, presumably because of that insatiable appetite of Chinese agencies' demand for US assets, leads to quite different results. See Figure 9. Certainly, the US enjoys the benefits of a real depreciation just as above, but the Euro now strongly appreciates—in nominal terms against both currencies, and in real effective terms. China, by forcing trade flows to follow its "capital account deficit," avoids the pitfalls of its policy induced appreciation, which instead are borne out fully by Europe, whose current account *and* exchange rate are market determined. In fact, Asia still experiences some real appreciation and the corresponding impact on demand and employment, but its real GDP just hovers around the base–year value, merely showing a negative change. US real depreciation, on the other hand, increases global demand for US traded goods, and if that demand does not come from Japan and China it has to come from Europe. The commensurate price changes are channeled through by the nominal Dollar–Euro exchange rate change.

6.2 Recession in the US

GDP growth in the US has slowed down considerably in recent quarters. The year–on–year growth of GDP in the first quarter of 2007 stands at 2%, the lowest since the recovery came in full effect at the beginning of 2003, and is even lower (1.3%) at an annualized rate.[43] It is, however, not a contraction of private consumption that puts a strain on GDP—wealth effects from the housing bubble might have been important fuelling household demand, but appear to be less relevant with a reversed sign, at least of yet. It is rather residential investment that is in full contraction. The year–on–year change in residential investment comes in at almost -17%, and the question is certainly not whether the construction sector will turn around soon, but rather how its collapse will propagate through the rest of the economy.[44]

[43] All statistics in this paragraph are from BEA Table 1.1.6. and the first quarter 2007 Advance BEA GDP news release. At the time of writing, the numbers are widely expected to be revised downward.

[44] The Home Builder's Association recently suggested that the residential construction sector might remain depressed well into 2011. [Reference]

1-L-X-CA[1,2]

Shock:	e[1, 3]	1.2	20%

Price variables				*Quantity variables*			
	US	EU	AS		US	EU	AS
Output price	3.8%	-3.6%	-2.7%	**Current Account (in $)**	16.7%	-49.9%	0.0%
GDP Deflator	2.2%	-2.2%	-1.6%	**Government Deficit**	9.2%	-4.4%	-2.7%
Real Wage	-2.2%	2.3%	1.6%	**Value Added**	3.2%	-2.3%	-1.8%
Nominal Exchange Rate	19.9%	20.0%	0.1%	**Labor Demand**	5.2%	-4.3%	-3.1%
Relative traded prices	6.5%	-2.8%	-3.8%	**Wage Share**	-0.2%	0.2%	0.3%
Traded/NT-price ratio	3.0%	-1.9%	-2.0%				

Figure 9: Simulation results: Rates of growth of selected aggregated variables after a policy–induced 20% nominal revaluation of Asian currency vis–a–vis the US Dollar. Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

Shocking investment appears to be one of the key simulation exercises for global adjustment. How would a sharp contraction in real investment in the (non–traded) construction sector affect the three regions and their links through foreign saving and trade flows? Furthermore, how would a contraction in business (traded–sector) investment impact global output and imbalances? Considering a full–blown investment–driven demand contraction in the US appears reasonable, given the dangerous combination of subprime lending–implosion, derivatives–explosion and the possibly nearing end of the credit cycle.

Obviously, this case has to be examined through a Keynesian lense, where investment levels are set by entrepreneur's "animal spirits," subject to our whims in a modeled world. We begin with a closure featuring a uniform wage rate and three exogenous exchange rates, shocked by a 25% reduction in both sectors' investment. Although it is probably a stretch to imagine the Dollar–Euro rate to be determined by policy rather than in financial markets or by trade flows, it is an illustrative example. See Figure 10 for results. As investment demand and consequently output X contracts in both sectors in the US, value added V decreases. The corresponding fall in profits on given capital stocks leads to a fall in Q. The fall in unit cost of value added has two (domestic) effects. First, goods prices fall with the reduction in costs. Secondly, employment falls because the real wage rises, given institutionally fixed nominal wage rates.

Internationally, the first of these—the fall in output prices—translates into proportional reductions in output prices abroad, both in Europe and Asia. With fixed nominal exchange rates the US' real exchange rate depreciates because the imported deflation is passed through only to the extent to which imports figure in the price formation, leaving $\Delta P^* - \Delta P > 0$ with $\Delta e = 0$. The induced inflation and the resulting real appreciation, however, are sufficient to stir the same vicious

1-L-X-CA[1,2,3]

Shock: Inv[US] -25%

Price variables	US	EU	AS
Output price	-6.4%	-3.0%	-2.3%
GDP Deflator	-6.9%	-2.6%	-1.9%
Real Wage	7.4%	2.7%	1.9%
Nominal Exchange Rate	0.0%	0.0%	0.0%
Relative traded prices	2.4%	-0.4%	-0.6%
Traded/NT-price ratio	0.8%	-1.3%	-1.4%

Quantity variables	US	EU	AS
Current Account (in $)	44.7%	-100.9%	-27.2%
Government Deficit	-35.1%	-9.4%	-5.3%
Value Added	-9.9%	-2.7%	-2.2%
Labor Demand	-15.4%	-5.0%	-3.8%
Wage Share	0.7%	0.2%	0.3%

Figure 10: Simulation results: Rates of growth of selected aggregated variables after a 25% real investment contraction in the US. Closure 1–L–X–CA[1,2,3]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

circle as in the US—a contraction of (export) demand brings about lower real value added, lower profits and prices and consequently lower employment. Lower real investment in the US translates into a global recession with falling income levels in all three regions. It is important to note that this pattern of adjustment occurs only because all three bilateral nominal exchange rates are fixed and output price changes in the US spill over unabated into the rest of the world.

To demonstrate this, we consider the same model with a slightly different international closure. Suppose only the US–Asia exchange rate is pegged, but Asian monetary authorities accumulate Dollar–reserves at any rate commended by their export prowess, while Europe lends a fixed amount (in Dollar terms) to the US, leaving the exchange rate to be determined by market forces.

How is such a contraction likely to play out? Suppose Asia desperately aims to hang on to its surpluses in the face of a US contraction. Thus, the US/AS–rate remains pegged, and its level of external lending is policy–determined. Unsurprisingly, such a combination of events does not bode well for either US or EU. The contraction in absorption in the US chips away at the trade deficit. The same contraction reduces profits, which deflate costs and output prices in the US, further contributing to external adjustment. Figure 11 shows the US current account more than halving. Europe, on the other hand, is subject to a flexible exchange rate, which has to carry adjustment given the peg in Asia. The Euro strongly appreciates against both other currencies, rendering imports so cheap that prices fall more strongly than in US, leading to a real appreciation of 6% in EU. The shock to international prices is large enough to push the EU–region into external deficit. The oil–exporting countries and Asia together run a surplus of roughly $320 billion vis–a–vis the other two regions, almost equal parts of which bought by US and EU.

In the following section we close with an investigation of combinations of shocks we consider most likely, and suggest stabilizing policies that help to attenuate negative effects of a looming

1-L-X-CA[1,2]

Shock: Inv[US] -25%

Price variables

	US	EU	AS
Output price	-3.1%	-9.7%	0.8%
GDP Deflator	-4.8%	-6.7%	0.2%
Real Wage	5.1%	7.2%	-0.2%
Nominal Exchange Rate	28.4%	0.0%	-22.1%
Relative traded prices	8.2%	-6.0%	-0.3%
Traded/NT-price ratio	3.5%	-4.9%	0.7%

Quantity variables

	US	EU	AS
Current Account (in $)	61.7%	-217.1%	0.0%
Government Deficit	-28.1%	-15.6%	-0.3%
Value Added	-7.0%	-6.8%	0.3%
Labor Demand	-11.1%	-12.5%	0.5%
Wage Share	0.5%	0.6%	0.0%

Figure 11: Simulation results: Rates of growth of selected aggregated variables after a 25% real investment contraction in the US. Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

global downturn.

7 Conclusions: Finding the right policy–mix

Ironically, the likelihood of a Democratic president entering the White House in 2008 increases the probability of hawkish budget policies. What would be the implications of attempts to reduce the US public deficit on top of a combination of shocks suggested above? What can Europe, what can Asia do in order to avoid a global slowdown?

To analyze a few selected scenarios, we apply an international closure probably most suitable for the situation at hand. US– and EU–current account are endogenous, whereas "Chinese" policymakers go to work to maintain large external surpluses—by maintaining a tight peg of the Asian currency to the Dollar at a "low" level. Internal balance remains investment–driven, and underemployment of labor is possible.

We construct a composite shock in the US. Suppose, as above, the US economy enters a recession led by (business) investment, and, in this model "behind the scenes," the resulting reduction of financial wealth actually does curb private consumption enthusiasm via an increase in personal saving rates. Figure 12 summarizes the simulation.

The *increase* in saving together with a *decrease* in investment obviously improves the external balance. The US current account to GDP–ratio declines from -3.9% to an almost balanced -1.3%. The necessary redirection of trade flows is brought about by a real depreciation of the Dollar against the Euro. While the recession domestically reduces profits, which deflate nominal value added and consequently output prices, the US/EU–exchange rate depreciates by 34%, lowering the relative price of the US good.

1-L-X-CA[1,2]

Shock: Inv[US], S[1]

Price variables

	US	EU	AS
Output price	-4.3%	-11.1%	0.9%
GDP Deflator	-6.4%	-7.7%	0.3%
Real Wage	6.8%	8.3%	-0.3%
Nominal Exchange Rate	33.5%	0.0%	-25.1%
Relative traded prices	9.5%	-6.9%	-0.4%
Traded/NT-price ratio	5.2%	-5.7%	0.8%

Quantity variables

	US	EU	AS
Current Account (in $)	71.9%	-253.0%	0.0%
Government Deficit	-34.9%	-17.4%	-0.3%
Value Added	-9.3%	-7.8%	0.3%
Labor Demand	-14.6%	-14.2%	0.5%
Wage Share	0.6%	0.7%	-0.1%

Figure 12: Simulation results: Rates of growth of selected aggregated variables after a combined shock of 5% to total US saving, and –10% to US real investment contraction in both sectors. Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

Secondly, outputs bear the brunt of the adjustment. The exact magnitude of the slump might be disputable, but the model suggests a severe recesssion in both US and EU. The latter's output takes the hit from losing export markets, primarily in the US, but as well in Asia.

Asia is broadly speaking able to shield itself from the negative effects, certainly due to the peg of the exchange rate, but moreover in this particular simulation because the Asian trade surplus is maintained at the base–year level.

Note that the external and public deficit move in opposite direction: The former more than halves, and the latter worsens. As tax revenues break away and the government sustains its "usual" expenditures, the deficit soars by more than a third.

As a worst case scenario, Figure 13 describes the same simulation, augmented by a *reduced* budget deficit in the US—a modest 10% less debt taken on during the next Congress. The patterns persist, the numbers worsen.

Now assume the EU can sustain its current expansion, even in the wake of a US recession. Suppose furthermore the US Congress is unwilling or unable to raise taxes and keeps the budget deficit at this years level. Figure 14 shows that real Dollar depreciation coupled with changes in absorption in US—$\Delta S_{US} > 0$ and $\Delta I_{US} < 0$—and EU—$\Delta I_{EU} > 0$—pushes the latter into external deficit. The EU now borrows almost $270 billion from abroad. The funds stem largely from Asia, which maintains its pre–shock net export levels, but are channeled through the US. The key, however, is that *even a healthy EU–investment expansion* does not prevent a global slowdown, here still a severe recession in the US and EU.

This paper is concerned with the adjustment of global imbalances. We advance a global demand–led general equilibrium model that allows for variety of causality assumptions feeding

1-L-X-CA[1,2]

Shock: Inv[US], S[1], B[1]

Price variables	US	EU	AS	*Quantity variables*	US	EU	AS
Output price	-8.1%	-17.8%	1.4%	**Current Account (in $)**	123.9%	-438.1%	0.0%
GDP Deflator	-11.6%	-12.1%	0.4%	**Government Deficit**	10.0%	-23.8%	-0.5%
Real Wage	13.1%	13.8%	-0.4%	**Value Added**	-16.8%	-12.4%	0.5%
Nominal Exchange Rate	61.4%	0.0%	-38.0%	**Labor Demand**	-25.5%	-22.0%	0.8%
Relative traded prices	16.3%	-11.6%	-0.7%	**Wage Share**	1.2%	1.1%	-0.1%
Traded/NT-price ratio	9.6%	-9.6%	1.2%				

Figure 13: Simulation results: Rates of growth of selected aggregated variables after a combined shock of 5% to total US saving, –10% to US real investment and –10% to the public deficit. Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

1-L-X-CA[1,2]

Shock: Inv[US], S[1], B[1] Inv[EU]

Price variables	US	EU	AS	*Quantity variables*	US	EU	AS
Output price	-7.6%	-11.5%	1.0%	**Current Account (in $)**	114.1%	-413.6%	0.0%
GDP Deflator	-10.6%	-6.7%	0.3%	**Government Deficit**	0.0%	-12.8%	-0.4%
Real Wage	11.8%	7.1%	-0.3%	**Value Added**	-15.4%	-6.9%	0.4%
Nominal Exchange Rate	41.0%	0.0%	-29.1%	**Labor Demand**	-23.5%	-12.5%	0.6%
Relative traded prices	13.3%	-9.2%	-0.5%	**Wage Share**	1.1%	0.5%	-0.1%
Traded/NT-price ratio	8.3%	-7.9%	0.9%				

Figure 14: Simulation results: Rates of growth of selected aggregated variables after a combined shock of 5% to total US saving, –10% to US real investment but holding public deficit constant; and a positive demand shock of 10% in Europe. Closure 1–L–X–CA[1,2]. Note that nominal exchange rates are e[1,2], e[1,3] and e[2,3], respectively. A fall in either real exchange rates is a real appreciation. Negative change in either current account or government deficit is a worsening from the base–year level for all three regions.

simulations.

Results suggest that no exchange rate changes—nominal or real—will be able to avoid changes in absorption. Further, if an adverse shock occurs the US might be ill–advised to contribute to the contraction by reducing the public deficit, and EU–members might have an interest in abandoning arbitrary budgetary ceilings in order to sustain the current expansion even in the face of a US downturn.

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		1	2	3	4	5	6	7	8	9
		T	NT	H	G	E	I	B	F	*Sum*
1	T	2,192	1,286	1,506		1,624	1,008			7,616
2	NT	1,386	4,318	6,500	1,950		1,532			15,686
3	W	1,647	5,772							7,419
4	P	1,049	3,556							4,605
5	Y(G)			1,590						1,590
6	FOF(G)				-360.48			360.48		0.000
7	FOF(P)			2,428			-2,540	-360.48	473	0.000
8	Capital-								-120	
9	flows								-280	
10	*OIL*	68	38			-89			-72	
11	Trade-	789	443							
12	flows	317	178							
13		169	95			-264				
14						-983				
15										
16										
17										
18						-288				
19										
	Sum	7,616	15,686	12,024	1,590	0.000	0.000	0.000	0.000	

Figure 15: "US" SAM

		1	2	3	4	5	6	7	8	9
		T	NT	H	G	E	I	B	F	*Sum*
1	T	2,474	1,139	1,736		3,473	709			9,530
2	NT	1,468	2,696	3,438	1,918		1,504			11,024
3	W	1,798	3,133							4,931
4	P	1,573	2,920							4,493
5	Y(G)			1,556						1,556
6	FOF(G)				-362			362		0.000
7	FOF(P)			2,696			-2,213	-362	-120	0.000
8	Capital-								120	
9	flows									
10	*OIL*	108	55			-172				
11	Trade-					-1,232				
12	flows									
13										
14		650	333							
15		1,147	587			-1,734				
16		312	161							
17										
18										
19						-335				
	Sum	9,530	11,024	9,424	1,556	0.000	0.000	0.000	0.000	

Figure 16: "EU" SAM

		1	2	3	4	5	6	7	8	9
		T	NT	H	G	E	I	B	F	*Sum*
1	T	2,368	950	995		1,563	566			6,442
2	NT	920	1,540	2,105	978		1,144			6,687
3	W	1,171	2,340							3,511
4	P	1,004	1,554							2,558
5	Y(G)			724						724
6	FOF(G)				-255			255		0.000
7	FOF(P)			2,245			-1,710	-255	-280	0.000
8	Capital-									0.000
9	flows								280	0.000
10	*OIL*	106	33			-75				0.000
11	Trade-									0.000
12	flows					-495				0.000
13										0.000
14										0.000
15										0.000
16						-473				0.000
17		397	123			-520				0.000
18		220	68							0.000
19		256	79							0.000
	Sum	6,442	6,687	6,069	724	0.000	0.000	0.000	0.000	

Figure 17: "Asia" SAM

	Costs	HH	Inv	For	Sum
Production		PC	PI	PE	PX
Factors	$wL + rK$				Y
Foreign	$eP'fX$				Y_F
FOF		S	$-PI$	S_F	0
Sum	PX	QV	0	Y_F	

Figure 18: A one–country, one–sector open economy SAM without government and intermediate goods.

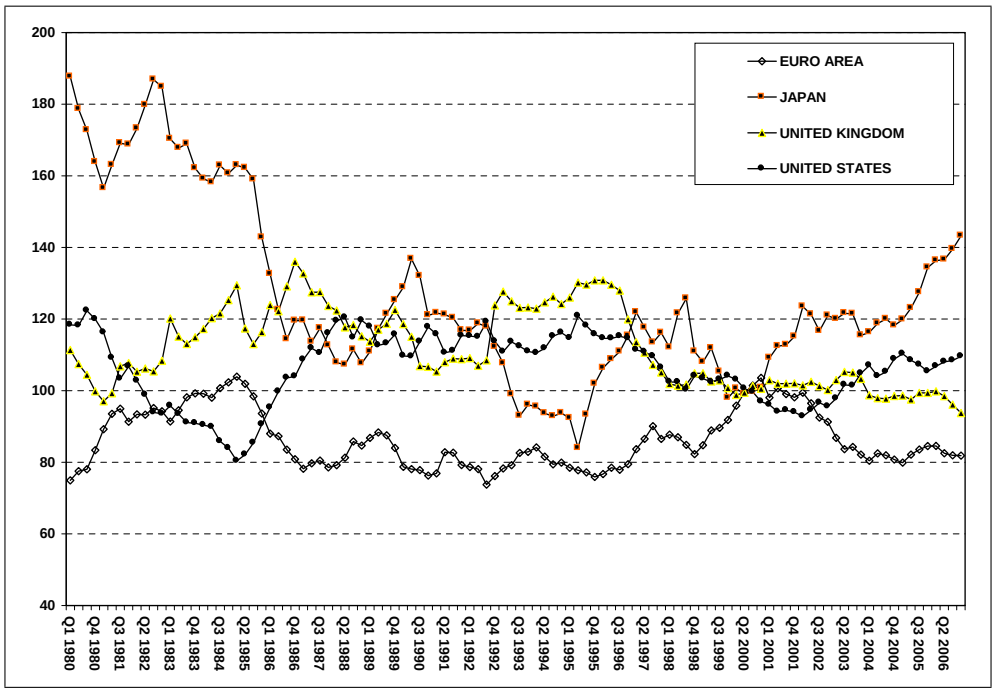

Figure 19: Real effective exchange rate indices of major currencies, 1980:Q1–2006:Q4. Source: International Financial Statistics (IMF) and author's calculations.

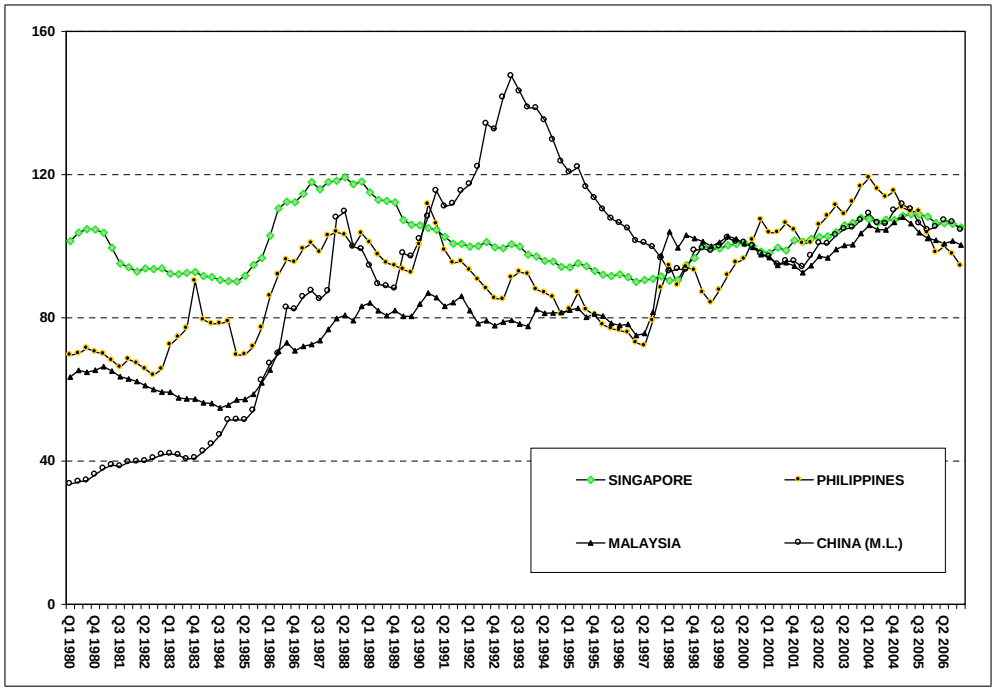

Figure 20: Real effective exchange rate indices of selected Asian countries, 1980:Q1–2006:Q4. Source: International Financial Statistics (IMF) and author's calculations.

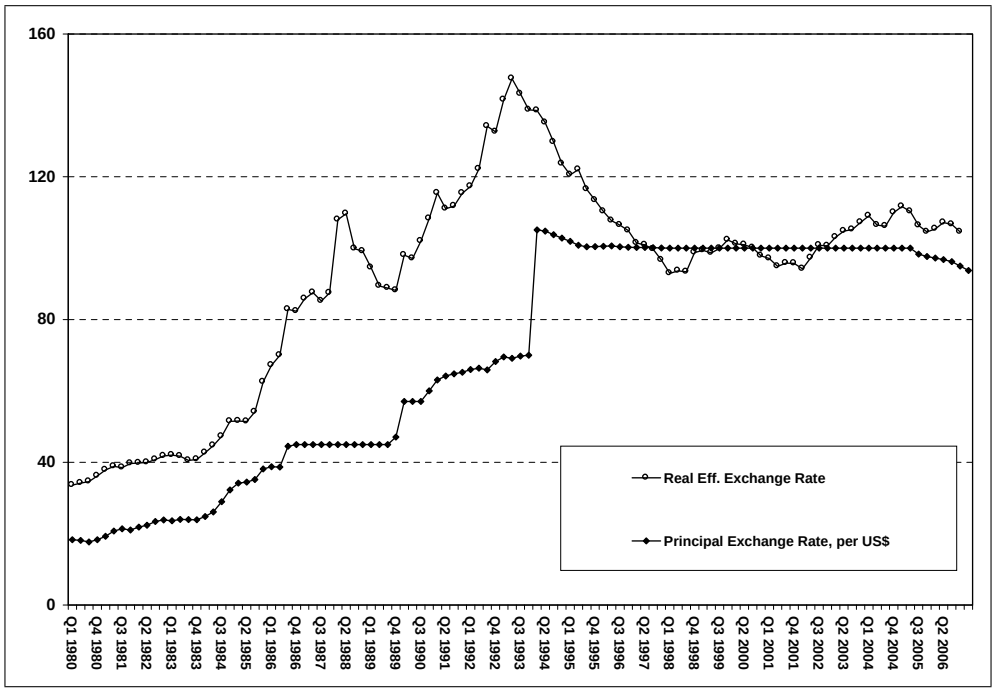

Figure 21: China's real effective and official exchange rate (per US$) indices, 1980:Q1–2006:Q4. Source: International Financial Statistics (IMF) and author's calculations.