A little bit of macro

Crucini/Driskill

May 8, 2016

Contents

1 Learning objectives

1. Review and deepen understanding of the distinction between real (microeconomic-based) and monetary (macroeconomic-based) models and analysis.
2. Understand the distinction between short-run and long-run.
3. Understand the determinants of money demand and supply.
4. Understand why price levels are proportional to money supplies.
5. Understand why the proportionality factor between the money supply and the price level depends on real variables such as relative prices and real factors such as payments practices.
6. Understand why the long-run nominal flexible exchange rate is, ceterus paribus, proportional to relative money supplies.
7. Understand why maintaining a fixed exchange rate means allowing the money supply to be endogenous.
8. Understand the basic concepts of the **trade balance** and the **current account balance**.
9. Understand why *bilateral* trade balances might always be non-zero.
10. Understand why the economy-wide budget constraint implies that the current account in any given period of time must equal the change in the value of *net* foreign assets from the previous period to this period.
11. Understand that the economy-wide budget constraint is different from an individual's budget constraint because it should not be viewed as a "menu" of feasible choices, but rather as a record of individual economic agent's decisions.
12. Understand why the present discounted value of an economy's exports, plus the economy's inherited wealth, must equal the present discounted value of imports.
13. Understand how this result allows us to reinterpret our simple static intratemporal trade model as a model that represents an economy over its lifetime, thus validating the implications of that static model about patterns of and gains from trade for more realistic, dynamic settings.

2 Introduction

2.1 Visiting the parents

After having read up to this point, it might be interesting to contemplate what might happen if you were to visit with people who have not read or studied this material–parents, for example, if you are a student. They might be interested in engaging you about current international economic events, hoping to learn from your newly-acquired knowledge.

If this hypothetical conversation were to have happened in 2008, a likely conversation might be about the value of the U.S. dollar vis a vis the Euro. Parents might wonder if your studies can help them know whether or not they will be able to afford to send you to Europe for your semester abroad in 2009. Or perhaps they have heard about the "problem" of the "huge" U.S. trade deficit, and wonder what you can tell them about it.

Or if the conversation took place in 2005, it might have been concerned with President Bush's November visit to Asia. On his agenda of topics for discussion were the intertwined issues of the bilateral trade deficit of the U.S. with China and the value of the Chinese currency, the renmimbi (also known as the yuan). The trade deficit was viewed as a problem in part because it provided political ammunition to protectionist politicians in the U.S. who argued that it reflected "unfair" Chinese advantages in the sale of such things as textiles and apparel to U.S. purchasers.[1] The "unfair" part of this was often alleged to arise because of the "artificially low" value of the Chinese currency vis a vis the U.S. dollar. This "low" value of the Chinese currency was alleged to be the result of the Chinese authorities maintaining a **fixed** or, in equivalent language, **pegged**, exchange rate vis a vis the dollar. The quotation marks around "low" are meant to alert us that we have no theory yet about what would be a correct value of a currency.

Of course, your response would have to be something along the lines of the following:

> "I cannot tell you anything about these interesting topical international economic issues. We have been learning about microeconomic models of trade: everything in these models are what economists call "real" variables such as relative prices. If you want to talk about something like the value of a currency, these models have nothing to say. As a matter of fact, I cannot tell you anything about what determines the prices we use everyday in our transactions, like the dollar price of a movie. Furthermore, all of these

[1] The quotations around "unfair" are meant to highlight the ambiguity that surrounds such a term when used in reference to trade. Is it unfair to sell things to United States consumers at lower prices than they would otherwise face? Is it unfair that Chinese producers of some products face lower labor costs because of their relatively large unskilled labor force vis a vis the U.S.? These questions are not what this section is designed to answer, but we note them to alert readers not to accept uncritically the implicit assumptions that use of this language implies.

> models have assumed (economists are fond of making assumptions, I've discovered) that the value of exports equals the value of imports, which means that trade deficits are zero. Gee, as I talk to you, I realize that this last assumption doesn't fit reality for any country I can think of–they all seem to have either deficits or surpluses. And that makes me wonder: are all those conclusions about the "gains from trade" relevant if the models on which they are based make such unrealistic assumptions?"

Perhaps now is the time to introduce a little bit of macroeconomics. This will not only allow you to have more intelligent conversations with parents and others who know you have been studying international economics, but will also help solidify your understanding of what microeconomic models have to teach us.

2.2 Revisiting the issues

The concern with the Chinese-U.S. bilateral trade balance and the value of the renmimbi vis a vis the dollar is not new. For example, as noted earlier, in the summer of 2003, the U.S. Secretary of the Treasury, John Snow, pushed China to let its currency "rise in value" against the U.S. dollar. That is, he argued that it took too few dollars to purchase one renmimbi. Because this subject concerns *currencies*, it is usually considered a macroeconomic topic.

Concern over the value of a currency are a frequent fixture of policy debates. In the first decade of the twenty-first century, for all the concern of a "low" value of the renmembi by U.S. officials there is similar concern by Europeans that the value of the U.S. dollar is "too low" vis a vis the Euro.

And concern over trade deficits is also an enduring policy topic over the last few decades. From concern over the U.S. trade deficit with Japan in the 1980's to current concerns with China to concerns over the U.S. trade deficit vis a vis the rest of the world, it seems that the only thing that changes is the name of the country whose policies are too blame (according to U.S. officials).

Economists usually consider trade deficits a macroeconomic topic, even though trade balances are frequently tied to discussions about exports and imports in the media. To understand why economists think this way, consider the former Secretary Snow's expressed concern about the renmembi. The reason given by Secretary Snow for his concern was that the lower price of the renmimbi made imported textiles and clothing produced in China cheaper relative to the price of those same goods produced in the U.S. That is, for a particular renmimbi price charged in China for these products, such as, say, two (2) renmimbi per T-shirt, the dollar cost of T-shirts to a U.S. importer is lower the lower is the dollar price of renmimbi's. For example, if it takes ten cents to buy a renmimbi (in equivalent terms, if the price is \$.10/yuan), a t-shirt would cost twenty cents (\$.20/t-shirt=2yuan/t-shirt$\times$\$.10/yuan). In contrast, if it takes twenty-five cents (\$.25) to buy a renmimbi, and the renmimbi cost of a t-shirt remains at two (2) renmimbi, then the t-shirt would cost the U.S. importer \$.50. Because

the lower dollar price of $.10/yuan implies a lower dollar price of t-shirts, ceterus paribus, this in turn implies t-shirts trade at a lower *relative* price vis a vis other goods and services in the U.S. A lower relative price implies reduced U.S output of t-shirts and increased U.S. t-shirt demand. Thus, Snow believed that the "low" value of the renmimbi increased imports of these goods from China and hurt the U.S. textile and clothing production sector.

Here is the rub: the determination of quantities of goods and services exported and imported is understood from an analysis of any and all of our "real" trade models such as the endowment economy model or the specific and mobile factors model. Such models teach us that exports and imports are functions of *relative* prices, and that these relative prices are themselves functions of the interplay of tastes, resources, and technology, the "real" components of the economy. Hence, if our analysis is correct, there can be no effect on exports and imports of changes in a *nominal* variable such as the nominal value of the renmimbi vis a vis the dollar.

What might Secretary Snow have meant, then? And why haven't a chorus of economists pointed out to Secretary Snow the impossibility of a change in the renmimbi/dollar exchange rate changing the quantities of exports and imports? (there has been no such chorus). One key to understanding the analysis that must underlie Secretary Snow's position is an understanding of the **long-run** applicability of "real" trade models and how the implications of these models must be modified when analyzing **short-run** phenomenon.

Such an understanding brings another benefit: an understanding of what determines the long-run values of nominal variables such as the exchange rate and the currency prices of good and services. This is one job that we undertake in this chapter.

What we cannot do here is develop any of the short-run models that would be candidates to help us understand how the nominal changes recommended by Secretary Snow might interact with the "real" economy. That job requires another course.

What we also do in this chapter is develop a rudimentary framework for organizing thought about trade deficits and surpluses. Again, we do not develop the full-blown model that helps us truly analyze how changes in exogenous factors can explain changes in trade deficits. That job also requires another course.

We first take up the development of a model that lets us understand the determination of nominal variables in the long run. We then take up trade and current account balances.

3 The monetary model

In this section we model the determination of nominal prices. The key elements are demand and supply of money. As usual, we assume there are just two countries. But before delving into the model itself, we need to cover some key new ideas and introduce some new terminology.

3.1 The long and short of "runs"

What do economists mean by "long run" and "short run?" Conceptually, the long run is a time segment sufficiently long that all dynamic adjustments of the economy to an exogenous change are completed. In practice, economists usually mean calendar time on the order of magnitude of multiple years or even decades, but certainly not quarters of a year or months. Days, months, and quarters-of-a-year are the units of measurement of "short runs." Adjustments from an immediate time to a "long run horizon" are made up of a sequence of short runs.

A physical analogy may aid understanding of the conceptual nature of the long run. Imagine a spring attached to the ceiling, and extended by the pull of gravity to some length l (such as one (1) foot, as an example). The spring is not moving at this point. Now imagine attaching a weight to this spring, and then letting go. The spring will stretch further than its initial length, and will probably bounce up and down awhile before coming to a rest at a new, longer length $L > l$ (perhaps, for example, two (2) feet). When the spring is not moving, either at length l or L, we would describe the spring as being in a **long-run equilibrium**. The changes in the length of the spring through time as it adjusts to the attachment of the weight would be describes as **dynamic adjustments**. At any moment in time during the dynamic adjustment period, a description of the length of the spring at this time, along with a description of the forces at work on the spring at this moment, would be called a **short run equilibrium**.

3.2 Some terminology

We will define the **nominal exchange rate** as the domestic currency price of a unit of foreign exchange, and we will symbolize this rate by E. For example, the New York Times reports on November 15, 2005, (page C16) that the price of a Chinese yuan on November 14 was **.1237** dollars. It also reports the yuan price of a dollar on Monday as **8.0826** yuan per dollar. In our terminology, the U.S.-Chinese exchange rate was **.1237** dollars/yuan on Monday.[2]

As suggested by the *Times'* reporting of both the dollar/yuan and the yuan/dollar rate, the designation of the nominal exchange rate as the domestic currency price of a unit of foreign exchange is not universal: some groups of people refer to the exchange rate as the foreign-currency price of a unit of domestic currency. This is all designed to make international economics so confusing that few people pursue it as an area of study, thus keeping the salaries of international economists artificially high.[3]

[2] The alert reader might note that the inverse of .1237 is 8. 084 1, not 8.0826. This probably just reflects that the numbers reported come from price quotes of different dealers in the foreign exchange market or from quotes at different times of the day; trades take place in the foreign exchange market at rates in the thousands/day.

[3] In reality, this is just like a number of other conventions that differ from country to country, such as which side of the road to drive on. In fact, quotes of the exchange rate as the foreign currency price of a unit of domestic currency are called **British terms**.

When an exchange rate (as we define it, namely as the domestic currency cost of a unit of foreign exchange) goes up, i.e., takes on a different, higher numerical value, it is said that the domestic currency has **depreciated** in value, or, in short, depreciated, vis a vis the foreign currency. This makes sense if we remember that if it takes more units of domestic currency to buy a unit of foreign exchange, then the value of the domestic currency in terms of foreign currency is lower. Hence, this is also referred to as a **devaluation** of the domestic currency. When an exchange rate goes down, it is said that the domestic currency has **appreciated** in value, or in short, appreciated vis a vis the foreign currency. This is also sometimes referred to as a **revaluation** of the domestic currency vis a vis the foreign currency.[4]

We are now ready to develop a simple "long run" model of exchange rates, nominal prices, and money supplies. As noted, by long run, we mean a time frame of years, or even decades, but certainly not of months or quarters of a year. We also mean that such a model will not describe the dynamic adjustments from one point of long-run equilibrium to another. Even with these limitations, though, it will afford us some ways of organizing thought about these shorter-run dynamic issues.

The building blocks (sub-models) of this model are a model of the market for money, which includes a model of money demand, a model of money supply, and an equilibrium condition of money demand equal to money supply. It also includes as a submodel the "real" models of international trade already developed.

This model is slightly different from the others we have developed in that the classification of exogenous and endogenous variables depends on a policy choice specification. Specifically, if we specify policy makers as deciding to control the money supply, then the endogenous variables of the model are the nominal exchange rate and nominal prices of goods and services. On the other hand, if we specify policy makers as deciding to control the nominal exchange rate, then the endogenous variables of the model are nominal prices and the nominal money supply.

In either case, though, the other exogenous components are tastes, resources, and technology. These determine *relative* prices, which in turn are a factor in determining the values of the other endogenous variables.

4 The market for money

As with most economic analyses, we use a traditional demand and supply model to understand the relationship between money and nominal prices. What is most different about the study of demand for money is that people don't consume money in the same fashion as they do goods and services such as pretzels and beer and entertainment and the like. Rather, it depends on the need in

[4] Some people reserve revaluation and devaluation for use in describing a change from one fixed value of a currency to another fixed value.

a commercial society to carry out transactions via the medium of exchange, money.

Here we take the simplest possible approach to modeling this difficult problem, based on the *transactions* motive for holding money. In such a theory, individual economic units are assumed to have exogenously specified patterns of expenditures on goods and services and exogenously specified patterns of receipts of income. These units take their incomes, and the prices of goods and services, as exogenous. Their endogenous, or choice, variable, is the quantity of money they need to carry out their transactions

Let us return to Radford's POW camp. As noted, but ignored until now, prisoners received cigarettes as part of their Red Cross endowment. These cigarettes soon became the **medium of exchange** within the camp: all transactions involved an exchange of some good for cigarettes. For example, if our POW Andy wanted to exchange coffee for tea, he sold his coffee for a certain amount of cigarettes, and then used these cigarettes to buy tea. This corresponds to our everyday experience now: when we sell something, say, for example, our labor services, we are paid with the medium of exchange used in our economy. This would be U.S. dollars in the United States, Euros in the European Union, Yen in Japan, and so on.

As noted in Chapter 2, the services of money in mitigating the costs of barter are obviously important and explain why most economies, even relatively simple ones like Radford's POW camps, end up with a medium of exchange. But taking as given that an economy uses money, the questions that arise are: what determines the demand and supply of money, and the values of what variables are determined by the interaction of demand and supply? We now turn to these questions.

4.1 Demand for money

4.1.1 Bridging the gap between payments and income receipts

The key idea behind the demand for money is that people get monetary payments at different times than the times at which they want to make purchases. To keep things as simple as possible, we will assume that the timing of these payments and purchases is exogenous to the individual. For most people, this is a realistic description of their payments practices: they have recurring expenditures and receipts, the timing of which is beyond their control. For example, many bills are due on a particular day of the month. And many expenditures are associated with events the timing of which is institutionally determined: many families spends money on entertainment on Friday and Saturday nights, because schoolwork and jobs keep them home on weeknights; and they may make contributions to a synagogue on Saturday or to a church on Sunday, because that is when the congregations meet. College students spend money on partying when everybody else does (meeting people is the goal), which is Thursday-Sunday at most universities. And on the income side, many people get paid at the same recurrent time, such as the end of the month. This timing,

for most people, is not open to negotiation but is determined by the employer and seldom changes.

For purposes of studying the demand for money, we assume that along with the timing of payments, incomes and prices are exogenous to the individual. Furthermore, much like in the movie "Groundhog Day," their payment habits are forever recurring: each week or month is just like the last. Given that their incomes and expenditures are not synchronized over the time interval, an individuals' problem is thus to bridge the gap in time between when they receive income payments and when they make purchases.

A concrete example may help understand this point. Imagine an individual who has the following pattern of expenditures and income over the course of a week:

Day	Price	Quantity	Expenditures	Price	Quantity	Income
Mon	20	15	300	10	10	100
Tues	20	1	20	10	10	100
Wed	20	9	180	10	10	100
Thur	8	1	8	10	10	100
Fri	10	9.2	92	10	10	100
Sat	20	3	60	10	10	100
Sun	20	2	40	10	10	100
Totals			700			700

That is, every Monday this individual spends $300 (this might be the weekly grocery shop, for example), every Tuesday $20, every Wednesday $180, and so on. On every day of the week this individual receives an income payment of $100, which is the product of the price ($10 in this example) for some endowment (like the endowments form the Red Cross in the POW camp, or endowments of labor) times the amount of the endowment (again,10 units of coffee or tea in the POW camp example, or 10 hours of labor). Note that we assume this individual is neither a borrower or a lender over the course of the week: total expenditures for the week equal total receipts for the week.

The question we pose is: How much money does this individual need to carry out the planned expenditures, given the pattern of income payments? We see that on Monday, expenditures are greater than income receipts by $200. This person couldn't carry out this planned expenditure without having at least $200 in money on hand. Let's assume this person indeed started the week out with $200 on hand. At the end of Monday, this person's money balances will down to zero.

On Tuesday, expenditures are less than receipts by $80, and the individual will now have money balances of $80. On Wednesday, expenditures exceed income receipts by $80, and the money balance goes to zero again. On Thursday, expenditures are less than income receipts, and money balances climb to $92. On Friday, another $8 is added to money balances, on Saturday another $40, and on Sunday another $60. Thus, on Sunday night, this individual has $200 available, and is ready to get through another week.

This sequence of transactions can be summarized in a table in which we keep track day by day of the cumulative deficit of expenditures over income receipts. Alongside this cumulative deficit total we keep track of money balances, which we denote by L.

	Cumulative Deficit	L=200
Mon	-200	0
Tues	-120	80
Wed	-200	0
Thur	-108	92
Fri	-100	100
Sat	-40	140
Sun	0	200

By starting the week with an amount of money equal to the maximum cumulative deficit incurred over the week ($200 in this case), this individual is capable of carrying out her or his planned expenditures every week forever and ever. This in fact is representative of a general rule: to carry out planned expenditures over a recurring time interval such as a week or a month, a person needs to start the interval with an amount of money equal to the maximum cumulative deficit incurred over that interval.

This might seem almost obvious, but it highlights the key reason people hold money balances: to bridge the gap between payments and receipts. To help see this point, consider another hypothetical individual with a different pattern of payments and receipts, one which is perfectly synchronized. This person's pattern is displayed in the following table:

Day	Expenditures	Income	Cumulative Deficit	L=0
Mon	300	300	0	0
Tues	20	20	0	0
Wed	180	180	0	0
Thur	8	8	0	0
Fri	92	92	0	0
Sat	60	60	0	0
Sun	40	40	0	0
Totals	700	700		

Such an individual would hold no money at the beginning of the week!

Or, imagine people who get paid once a month, and who can charge all of their purchases on a credit card. If they can pay their credit card on or near the same day that they get paid, they also have no need for money!

4.1.2 The demand for money function

The effect of changes in prices What are the features of the demand for money that are implied by this simple model? First imagine that the nominal price of some goods changed, such as an increase in the price of groceries.

Such a change would generate changes in the pattern of payments and receipts. Without more information about an individuals preferences, we cannot know in exactly what fashion the pattern of payments and receipts would change. For example, the greater expenditures on groceries such a change would entail might be accommodated by a reduction in spending on "fun" over the weekend. The exact changes in the pattern of expenditures and receipts could be almost anything. What we can say is that in general, a change in any nominal price should affect the demand for money. We would symbolically represent this by writing that the demand for money is a function of all possible nominal prices:

$$L^d = f(P_1, P_2, ..., P_n; \overline{Y}) \tag{1}$$

where currency prices of goods and services are symbolized by the variables $P_1, P_2, ..., P_n$. Included in these prices would be the prices received for endowments. We include the variable $\overline{Y}$ to signify "real" income, which would be a list of all the endowments available to the individual. We put an overbar on Y to emphasize that it is exogenous. We will see shortly why it is an argument in the function.

As uninformative as this general description of money demand is, it leads the way to an understanding of perhaps the key feature of the demand for money: the *proportionality* of money demand to equiproportional changes in every nominal price. That is, if all nominal prices increase by a certain percentage, then the demand for money increases by the same amount.

To see this, consider the pattern of payments and receipts illustrated in the first chart. Suppose all prices in this individual's world doubled. Here we include the prices paid the individual, such as his or her wage, or his or her payments for the various things consumed. What happens to the amount of money held at the beginning of the income-expenditure cycle that is necessary to get this individual through the cycle?

Because all nominal prices are assumed to double, there is no change in relative prices, and hence no change in quantities bought and sold. This means every entry in the expenditure column doubles as does every entry in the income column. This pattern is exhibited in the table of expenditures and receipts along with the associated cumulative deficits for this case.

Day	Price	Quantity	Expenditures	Price	Quantity	Income
Mon	40	15	600	20	10	200
Tues	40	1	40	20	10	200
Wed	40	9	360	20	10	200
Thur	16	1	16	20	10	200
Fri	20	9.2	184	20	10	200
Sat	40	3	120	20	10	200
Sun	40	2	80	20	10	200
Totals			1400			1400

How much money is now needed for this individual to carry out her or his planned expenditures? We note that the maximum cumulative deficit has also doubled, as illustrated in the table below.

Day	Expenditures	Income	Cumulative Deficit	L=400
Mon	600	200	-400	0
Tues	40	200	-240	160
Wed	360	200	-400	0
Thur	16	200	-216	184
Fri	184	200	-200	200
Sat	120	200	-80	280
Sun	80	200	0	400
Totals	1400	1400		

This illustrates the key feature of money demand: an equiproportionate increase in all nominal prices leads to an equiproportionate increase in the quantity of money demanded.

Most discussion of nominal prices, though, focus on an **index** of all the myriad nominal prices in an economy. To relate this to our money demand theory, define a price index, P as some weighted average of the individual nominal prices. This index is also referred to as the **price level**.

To fix ideas in a memorable way, we will focus on a two-good example, such as we used in the "real" part of the model. An index is designed to capture the idea of what would be the cost of a **basket of goods.** For example, in a two-good case of coffee and tea, we could ask what would be the cost of a combination of $\frac{1}{3}$ unit of coffee and $\frac{2}{3}$ units of tea, when coffee and tea cost (in nominal terms) P_c and P_T, respectively. The nominal cost of this bundle would be

$$P = \frac{1}{3}P_C + \frac{2}{3}P_T.$$

More generally, in parametric form we could have:

$$P \equiv \alpha P_C + (1-\alpha)P_T \tag{2}$$

where α is a positive fraction.[5]

We have established that If we change all nominal prices in the economy by the same proportion, the demand for money changes in that same proportion. This means that if all nominal prices are multiplied by the same number, say $\frac{1}{P}$, where P is the price index, then the demand for money is multiplied by that number. Hence, we can write

$$\frac{L^d}{P} = l(\frac{P_1}{P}, \frac{P_2}{P}, ...1; \overline{Y}). \tag{3}$$

We might call this function the **real demand for money**, because it measures the demand for money in units of a basket of commodities.

Should we be concerned that we don't know more about how changes in the arguments of equation (21) affect the real demand for money? Not really.

[5] We could also have the less familiar but still possible index: $P = (P_C)^{\alpha}(P_T)^{1-\alpha}$. This index, and even more unfamiliar but more general indices all work for our problem of deriving money demand properties.

Remember that the "real" model developed in the first part of the chapter determines the *relative* prices in an economy, namely $\frac{P_C}{P_T}$. This means that once we have specified the exogenous components of the real model, namely preferences and endowments, then the relative price of cloth is determined, and is just a number, which we will represent parametrically as θ. This implies that $P_c = \theta P_T$. Now, the price level, P, is the weighted average of P_C and P_T :

$$P = \alpha P_C + (1 - \alpha) P_T,$$

so

$$\begin{aligned} P &= (\alpha\theta + 1 - \alpha) P_T; \quad (4) \\ P &= (\alpha + \frac{1-\alpha}{\theta}) P_C. \quad (5) \end{aligned}$$

Hence, once the "real" model had determined θ, we can solve for $\frac{P_C}{P}$ and $\frac{P_T}{P}$:

$$\begin{aligned} \frac{P_C}{P} &= \alpha + \frac{1-\alpha}{\theta}; \\ \frac{P_T}{P} &= \alpha\theta + 1 - \alpha. \end{aligned}$$

The variables $\frac{P_C}{P}$ and $\frac{P_T}{P}$ are the relative price of cloth and tea, respectively, with respect to the price level, and are, like the other more familiar relative price $\frac{P_C}{P_T}$, determined by the "real" model. Hence, our real money demand function can be thought of as expressing a proportional relationship between the demand for money, L^d, and the price level, P :

$$L^d = kP$$

where k is the number given by $l(\frac{P_C}{P}, \frac{P_T}{P}; \overline{Y})$.

The effect of changes in endowments What happens to the demand for money if the resources available to an individual for generating income increase? For example, suppose $\overline{Y}$ were to double?

In general, we can't say much about what would happen, because without more detailed knowledge of preferences, we don't know what the effect of the increased income would be on the various demands for goods and services bought throughout the week. That is, it might increase or decrease the degree of synchronicity between payments and receipts.

But a useful benchmark assumption is the special case in which the increase leads to an equiproportionate increase in expenditure on each and every good. In terms of our example of a week of expenditures, this would lead to the following table.

Day	Price	Quantity	Expenditures	Price	Quantity	Income	Cumulative Deficit	L=400
Mon	40	15	600	10	20	200	-400	0
Tues	40	1	40	10	20	200	-240	160
Wed	40	9	360	10	20	200	-400	0
Thur	16	1	16	10	20	200	-216	184
Fri	20	9.2	184	10	20	200	-200	200
Sat	40	3	120	10	20	200	-80	280
Sun	40	2	80	10	20	200	0	400
Totals			1400			1400		

In terms of its effect on the maximum cumulative deficit and the demand for money, doubling of resources has the same effect as a doubling of prices: for each day of the week, both incomes and expenditures have doubled, so the demand for money has doubled.

We summarize these implications by writing the demand for money function as being proportional to both the price level and real income:

$$L^d = kP\overline{Y}. \tag{6}$$

where k is a number determined by the the factors that lead to more or less synchronization of payments and receipts in the economy and by the values that relative prices take.

This form of a money demand function is often associated with the quantity theory of money, and can be thought of as saying that the demand for money is proportional the level of expenditure. What this more complete development of the demand function adds is an understanding of what things might affect the value of k. In particular, changing payments practices such as brought about by the widespread use of credit cards, and other "real" changes that might affect relative prices, can change k. This is important because it will have implications for the equilibrium determination of the price level.

Analogous reasoning leads us to specify a foreign-country demand for its money:

$$L^{*d} = k^* P^* \overline{Y}^*, \tag{7}$$

where the "star" superscript denotes that the variable or parameter is for the foreign country.

4.1.3 What about the effect of interest rates?

For most households, the above theory of the demand for money is appropriate. But some wealthy households and many firms have sufficiently large cumulative balances that it becomes feasible and optimal for them to pay brokerage fees to move some of these balances into higher-interest assets. For these economic entities, the demand for money is inversely related to the nominal interest rate, ceterus paribus. Thus, the aggregate money demand function is proportional to nominal prices, with the factor of proportionality is an increasing function real income and a decreasing function of the nominal interest rate.

For simplicity, we will ignore this dependence of aggregate money demand on the interest rate. Again, this feature is dealt with in detail in Part III of the book.

4.1.4 Completing the model

Notice that for the home-country individual and foreign individual, P and P^*, the domestic and foreign price levels, respectively, are assumed exogenous: a higher value of P (P^*) leads to a higher demand for money. To understand the determination of P and P^*, we need the other blades of Marshall's scissors, the supplies of money.

4.2 Money supply

International economics adds an extra dimension to the problem of modeling a monetary economy, because countries may have flexible or fixed exchange rates. This choice has implications for the money supply process. We take up flexible rates first.

4.2.1 Flexible exchange rates

In this, our introduction to a complete general equilibrium model, we make the exceptionally simple assumption that the money supply is simply some exogenous number. For example, in the POW camp, where cigarettes were the medium of exchange, the supply of money would be determined by the number of cigarettes supplied through the Red Cross.[6]

Thus, we make the extremely simple assumption that the supply of money, denoted L^S, is exogenous:

$$L^S = \overline{L}.$$

The same is true for the foreign country:

$$L^{*S} = \overline{L}^*.$$

Money market equilibrium In equilibrium, demand equals supply:

$$\begin{aligned} \overbrace{\overline{L}}^{L^S} &= \overbrace{kP\overline{Y}}^{L^d}; \\ \overbrace{\overline{L}^*}^{L^{*S}} &= \overbrace{k^*P^*\overline{Y}^*}^{L^{*d}}. \end{aligned}$$

Solution

[6] This is actually true only if we assume the POW's were health-conscious and didn't smoke. If the POW's did smoke (as some of them did), then the supply of money becomes endogenous. This complication leads to a fascinating but more complex analysis of what is called a commodity money standard.

The price levels Let us remind ourselves of what are the exogenous components of the parts of the above equilibrium conditions. The money supplies are exogenous by assumption. The factors of proportionality for money demand, k and k^*, are exogenous, with their actual numerical values determined by the values of the relative prices in the economies and by such features of the economies as how often people get paid and whether they use credit cards. And $\overline{Y}$ and $\overline{Y}^*$ are exogenous. Thus, the only endogenous variable in each equilibrium-condition equation are the price levels, P and P^*. Hence, the solution to this sub-model of the monetary part of the economy is found by solving for P (P^*)in each of the equilibrium-condition equations:

$$\widehat{P} = \frac{\overline{L}}{k\overline{Y}}; \tag{8}$$

$$\widehat{P}^* = \frac{\overline{L}^*}{k^*\overline{Y}^*} \tag{9}$$

This solution tells us that price levels are proportional to own money supplies: if, ceterus paribus, the money supply increases by, say, 20%, then the price level increases by 20%.

This is a *qualified* prediction of the model, because of the ceterus paribus assumption. The "ceterus paribus" here relates to the values of k and $\overline{Y}$, which are determined or are part of the "real" side of the economy.

In many actual economies over relatively long periods of time, though, this qualified prediction has been approximately born out by data. This suggests that often, though not always, the "real" components of the economy change rather slowly through time, relative to changes in money supplies. And in periods when changes in money supplies are dramatic over short periods of time, such as during hyperinflation or during World War I, these money-supply changes dwarf and "real" changes. For such episodes, the prediction of proportionality between money supplies and price levels is validated.(**data here)**

Nominal individual commodity prices With knowledge of the determinants of the price levels, it is an easy step to determine what each individual nominal commodity price is. Remember that, because the *relative* price of coffee vis a vis tea is known from the solution of the "real" model, each nominal commodity price is related to the price level as in equation (4) and (5), repeated here with the relationship depicted for both domestic and foreign countries:

$$P = (\alpha\theta + 1 - \alpha)P_T; P^* = (\alpha^*\theta^* + 1 - \alpha^*)P_T^* \tag{4.i}$$

$$P = (\alpha + \frac{1-\alpha}{\theta})P_C; P^* = (\alpha^* + \frac{1-\alpha^*}{\theta^*})P_C^*. \tag{5.i}$$

That is, from each of the above equations, we can solve out for the nominal commodity prices $P_C,\ P_T,\ P_C^*,$ and P_T^* as a function of P and P^*, respectively.

Determining the nominal exchange rate: Miller time! We make the simplifying assumption of zero transport costs. This implies that the price

of each commodity, *measured in the same currency price*, must be equal:

$$\begin{aligned} P_T &= EP_T^*; \\ P_C &= EP_C^*. \end{aligned}$$

This is frequently described as **the law of one price**. In words, it says that the domestic currency price of tea equals the dollar price of the foreign currency (E) times the foreign currency price of a unit of tea, and likewise for coffee. If it were not true, profits could be made by buying the commodity wherever the domestic-currency price was smaller and transporting it (at assumed zero cost) to where the domestic currency price is higher.

From equations (8) and (9), we know the relationship between price levels P and P^* and the exogenous values of money supplies $\overline{L}$ and $\overline{L}^*$, real incomes $\overline{Y}$ and $\overline{Y}^*$, and the exogenous parameter values α and α^* and k and k^*. These price levels are related to the commodity prices P_T and P_T^* by equations 4.i:

$$\begin{aligned} \overbrace{(\alpha\theta + 1 - \alpha)P_T}^{P} &= \frac{\overline{L}}{k\overline{Y}}; \\ P_T &= \frac{1}{(\alpha\theta + 1 - \alpha)} \times \frac{\overline{L}}{k\overline{Y}} \end{aligned} \tag{6}$$

$$\begin{aligned} \overbrace{(\alpha^*\theta^* + 1 - \alpha^*)P_T^*}^{P^*} &= \frac{\overline{L}^*}{k^*\overline{Y}^*}; \\ P_T^* &= \frac{1}{(\alpha^*\theta^* + 1 - \alpha^*)} \times \frac{\overline{L}^*}{k^*\overline{Y}^*}. \end{aligned} \tag{7}$$

Now, from the law of one price, we know that

$$E = \frac{P_T}{P_T^*}. \tag{8}$$

Dividing equation (6) by (7) gives us $\frac{P_T}{P_T^*}$ just as a function of exogenous variables and parameters. Hence, substituting this relationship into equation (8) gives us the *solution equation* for the nominal exchange rate:

$$E = \frac{(\alpha^*\theta + 1 - \alpha^*) \times k^* \times \overline{Y}^* \times \overline{L}}{(\alpha\theta + 1 - \alpha) \times k \times \overline{Y} \times \overline{L}^*}. \tag{9}$$

Among other things, this solution equation tells us that the nominal exchange rate is, ceterus paribus, *proportional* to relative money supplies, where the factor of proportionality depends on the ratio of foreign to domestic real incomes, the ratio of foreign to domestic real money demand parameters k and k^*, the parameters from the price indices α and α^*, and the relative price θ.[7]

[7] Arbitrage also ensures that $\theta = \theta^*$.

The solution for the nominal exchange rate described by equation (9) is sometimes called the **purchasing power parity theory of exchange rate determination**. Its most tested proposition is the proportionality relationship between relative money supplies and the nominal exchange rate. When we look at relatively long periods of time, this proportionality relationship is not a bad description of the data. Over short periods of time, this is not true. This shouldn't surprise us, because we stipulated that this was a long-run model.**DATA HERE**

Fixed exchange rates What happens when a country decides to fix its exchange rate vis a vis another currency? First, to do this, it must have some foreign exchange in its possession so it can stand ready to buy and sell foreign exchange at the price at which it desires to fix it. If a government can credibly commit to do this, foreign exchange will never be bought or sold at a different price. No one would ever buy at a higher price, and no one would ever sell at a lower price.

So let us assume a government has sufficient foreign exchange in its possession so that it succeeds in fixing (or **pegging**) the exchange rate at some value $\overline{E}$. What are the implications for the other endogenous variables in the model, and what are these variables?

To sort this out, let us work backwards from equation (9). If in fact the nominal exchange rate is fixed at some value $\overline{E}$, then what variables on the right-hand side could be thought of as capable of changing value to make sure that equation (9) still held?

From our development of the model to this point, the only possible candidate would seem to be the money supplies $\overline{L}$ and $\overline{L}^*$: everything else is either determined in the "real" model, or is a parameter that reflects someone's behavior that is exogenous.

Our logic is correct here: if a government decides to peg its exchange rate, it gives up control of its money supply. For example, if we think about the U.S. and China, and assume for simplicity that the U.S. is "large" and maintains an exogenous amount of money $\overline{L}$, then if China fixes its nominal exchange rate vis a vis the U.S. it must be that its money supply $\overline{L}^*$ must be that value that makes equation (9) true.

How does the money supply adjust? Imagine a situation in which we start with a time in the past when money supplies and price levels were such that equation (9) was satisfied. To be concrete, imagine that the Chinese-U.S. exchange rate at that time was six (6) yuan/dollar,and the currency prices of tradeable goods were one (6) yuan per unit and one (1) dollar per unit. At these prices, the yuan price of a unit of the traded good is the same in China and the U.S.–six (6) yuan per unit.

Now imagine that the Chinese government decided to peg the exchange rate at 8 yuan/dollar. At *unchanged price levels* in the U.S. and China, this would mean that the yuan price of goods in China–six (6) yuan–was less than the yuan price of those same goods in the U.S.–eight (8) yuan per unit. At such

prices, arbitrageurs in search of profit would buy the goods in China at six (6) yuan/unit, ship them to the United States and sell them there for one (1) dollar, and sell that one dollar in the foreign exchange market for eight (8) yuan.

Now, in the foreign exchange market, these new supplies of dollars by the arbitrageurs would have to be bought by someone, or else the yuan price of these dollars would fall. To keep the yuan price of dollars from falling, the "someone" who must buy these new supplies of dollars must be the Chinese government.

When the Chinese government buys these dollars, it must pay for them with yuan. This puts more yuan in public circulation, which is an increase in the Chinese money supply.

What brings this sequence of events to an end? The increase in the Chinese money supply increases the yuan price of goods in China. When this increase is sufficient to eliminate the arbitrage profit opportunity, the money supply and the price level will stop rising.

DATA?

This is just a thumbnail sketch of the dynamic story of adjustment of money supplies and price levels under fixed exchange rates. The fully-developed model must wait until Part III. For now, simply realize that the choice of fixing an exchange rate implies that the country that does so gives up control of its money supply. This means it gives up control of its price level as well, because price levels and money supplies must be proportional.

5 The determination of nominal variables: recap and conclusion

In chapter three (3) and four (4), we constructed a "real" general equilibrium model of an exchange economy. In those models we showed that the equilibrium values of real variables, namely relative prices, quantities consumed by each individual, and levels of well-being of each individual, are determined by the interplay of the exogenous components of the model, namely tastes (or equivalently, preferences) and endowments. These equilibrium values are independent of the monetary side of the economy.

What, then, determines the nominal (or equivalently, currency) prices of goods and services in such an economy? Ceterus paribus, nominal prices are proportional to the money supply. That is, other things held constant, an increase in the money supply of $x\%$ leads to an increase in nominal prices of $x\%$.

These "other things" that are held constant are "real" variables, including the payments practices of the economy and the relative prices that we determined independently of the monetary part of the economy.

Notice that these results imply that we can study the "real" part of the economy independently of the monetary part. The converse is not true, though: real things may enter into the determination of nominal prices because they

may affect the demand for money. This is why we developed the "micro" or, equivalently, "real" model of a general-equilibrium economy before introducing the monetary side.

Once we know the nominal prices of goods and services in each country, we can use the **law of one price** to determine the nominal exchange rate under conditions of flexible exchange rates. The key implication of this theory is that, ceterus paribus, the nominal exchange rate is proportional to the relative domestic money supply vis a vis the foreign money supply.

With fixed exchange rates, what we find is that money supplies and associated price levels must move to accommodate the fixed exchange rate.

We include the analysis of the monetary part of the economy along with the real part for two reasons. First, our everyday experience of actual economies is grounded in nominal prices: few of us explicitly think in terms of relative prices, even though it is relative prices that must be those variables that affect our choices of what and how much to purchase. It helps to know that the nominal variables we are most familiar with are in fact related to the relative prices of microeconomics.

Second, most people's everyday experience of the international economy focuses on the nominal exchange rate. Understanding the monetary part of the economy allows us to have a rudimentary theory of the nominal exchange rate between countries. This helps us relate the relative prices of our real model to the more familiar nominal exchange rate.

6 Back to the parents: what about trade deficits?

Your parents might be relieved to learn that you now have a rudimentary knowledge of those monetary variables that crop up in the news so often. But what about that other newsworthy topic, the dreaded trade deficit?

In this section we give a brief introduction to the concepts that underlie an analysis of the trade balance (and other related balances). Again, a fuller understanding requires you to study Part III of this book. Here we hope to do two things: give you enough information to avoid some of the more common pitfalls in thinking about these topics, and give you the framework that lets you understand why the implications of our real models are not invalidated by real-world existence of non-zero trade balances.

7 An introduction to international accounting identities

Almost always, prominent themes in the business and economics news and in trade policy debates are the status of the **trade account** and the closely related **current account**. Briefly, the trade account is a record of the value of transactions undertaken between economic units of different countries for goods

and services. The current account includes along with trade account transactions the value of international transactions for a special type of service, namely what are called **net factor payments**, which are, loosely speaking, payments to factors of production. These factor payments include such things as interest payments from borrowers in one country to lenders in another, repatriations of profits earned in one country by foreign firms, and repatriated labor earnings earned by foreign workers.

The news frequently expresses concern over the magnitude of the trade account or current account **deficit**. The trade account is in deficit when the value of imports of goods and services exceeds the value of exports. It is in **surplus** when the value of exports exceeds the value of imports. It is in **balance** when the value of exports equals the value of imports. For the United States, for the year 2005 the trade **deficit** was approximately 717 billion dollars, and the current account **deficit** was approximately 705 billion dollars.

To gain perspective on these magnitudes, for the United States, for the year 1980 the trade **deficit** was approximately 21 billion dollars, and the current account **deficit** was approximately 28 billion dollars. Of course, over these twenty-five years from 1980 to 2005, the size of the U.S. economy increased and the purchasing power of a dollar decreased. A better measure of the magnitude of the changes in these trade and current account numbers is found by looking at the trade balance/GDP and current account/GDP ratios for these two years. In 1980, U.S. GDP was $2789.5 billion, while in 2005 it was $12,730 billion. Thus the trade balance-GDP ratio went from about -.7% in 1980 to about -5.6% in 2005, while the current account-GDP ratio went from about -1% to about -5.5%.

More DATA

The concerns raised about such deficits are, among others, how long they can continue before a "correction" takes place, and whether the deficits represent lost domestic jobs. We put quotation marks around "correction" to emphasize that we don't have a theory of what might be wrong with a particular value of the trade deficit that would require a change. Seldom in the popular press are deficits considered anything but bad and in need of correction, though.

These concerns are not fleeting because, for most countries at most times, trade account and current account balances are not zero. Thus, a model useful for analysis of most relevant real world situations must be capable of analyzing trade and current account deficits and surpluses.

The basic trade model we have developed so far is unable to do this because it *assumes* that the value of exports equals the value of imports. That is, this basic model assumes that the **trade account** and **current account balances** are zero.

Thus, we need a different model that is capable of analyzing situations with unbalanced trade and current accounts. That is, we need a model that explains the existence and pattern of trade and/or current account deficits or surpluses.

This chapter does *not* develop such a model. We have a much more modest goal here, and that is to introduce some international accounting identities that help us organize thought about trade and current account balances. The

development of a full-blown dynamic model is done in Part III. These accounting identities, though, expose the importance of borrowing and lending and associated levels of international indebtedness to an understanding of trade and current account balances.

The issues of borrowing and lending that underlie questions of indebtedness are inherently dynamic: they depend on choices people make about *when* to consume. Thus, analysis of these issues require **dynamic models**. Such models have logical connections that link the values of variables through time; that is, they incorporate **intertemporal considerations**. In contrast, our basic trade model is **static**: everything is assumed to take place during one time period.

Even without developing the full-blown dynamic model of Part III, can accounting identities can tell us something about the link between the static trade model and trade and current account deficits. In particular, knowing that our basic static trade model assumes balanced trade, which is not often observed in actual economies, the natural question arises of what implications from our basic model can be applied to a world in which trade is not balanced? Of most importance, do the implications about "gains from trade" still apply?

To answer this question, we look at some very general implications that arise just from consideration of the budget constraints faced by individuals in an intertemporal world. This exercise will demonstrate that an appropriate interpretation of our simple static model, even with its zero trade balance assumption, makes their implications applicable to the observed reality of a world with trade deficits and surpluses.

Along the way, we expose some common fallacies about trade and current account imbalances that are common in media discussions of these ideas.

8 Some general intertemporal features

In preparation for analyzing the implications of budget constraints in an intertemporal model, we will start with an introduction to how economists think about keeping records of transactions. We begin with an example most familiar to people, an example of a record of an individual's transactions over a period of time. We show how these records form the basis of an individual's budget constraint. We then move on to the slightly more complex example of the transactions records over a period of time of all the members of country, and how these records form the basis of what we call a nations's budget constraint. As usual, for expositional purposes we keep the dimensions of our analysis as small as possible. Unfortunately, this still requires us to use a model with three (3) countries and four (4) individuals.

Thus we think of the "home" country (to be concrete, the USA) as being composed of only two individuals, Alex (A) and Bobby (B). We also imagine there are two (2) other countries in the world, say, for concreteness, the United Kingdom and ROW (the "rest of the world"). For expositional simplicity, we assume there is only one citizen in the UK, Charley (C), and only one in ROW,

Pat (P).

Country	Citizens
USA	A(lex),B(obby)
Great Britain	C(harley)
ROW	P(at)

Countries and citizens

These records of transactions are parts of an interrelated set of accounting identities that help us organize thinking about intertemporal relationships in international economic models. Identities, which are true by definition, are never the heart of economics, which is the modeling of behavior. Nonetheless, the classifications of various transactions that make these identities informative are motivated by underlying theoretical ideas about behavior, and provide a useful jumping off point for a study of intertemporal linkages. One important caveat should be kept in mind about these accounting identities, though: they express relationships between *endogenous* variables, and thus capture *correlations* among variables, not *causality.*

8.1 Records of transactions, budget constraints, and accounting identities

We introduced earlier the concept of a budget constraint: an equation that specifies, for given prices of all conceivable goods and services that could be purchased, all the *possible* combinations of these goods and services that, if purchased in a unit of time, would have a total or aggregate expenditure that is not more than the available income.

We motivated this concept by noting that most of us have at one time in our lives constructed a **budget**: a list of contemplated, i.e., planned, expenditures on various things over an interval of time and a list of contemplated receipts from the sale of various things over that same interval of time. For example, a prospective college student might make a list of planned expenditures for a semester, such as payments for books, dues paid to clubs, fraternities and sororities and the like, expenditures on laundry, and so on. The student would also make a list of planned sales that generate income flows (also known as receipts) over the semester, such as wages from a part-time job, money from home (this might be thought of as "sale" of love, affection, and deep appreciation for all the things the parents have done for the student), and so forth. Such a list would have the feature that the value of expenditures equals the value of receipts.

In preparation for constructing such a budget, most of us also have experience with keeping a historical record of all of our transactions over a period of time, so as to have an idea of what are our historical **expenditures,** usually associated with purchases of some items, and historical **receipts**, normally associated with sales of some items (such as a person's labor), over a period of time.

In a world in which we take account of intertemporal considerations, what differs from our earlier model is the possibility of the purchase and sale of **assets**. Economists find it useful to dichotomize the universe of things bought and sold by individuals into **goods and services**, e.g., food, entertainment, haircuts, automobiles, and **assets**, e.g., bonds, stocks, houses, plant and equipment. The usefulness of this classification scheme arises because economists feel they have one useful *behavioral theory* about why people purchase or sell goods and services and another, distinct, behavioral theory about why people purchase or sell assets.

Let us now illustrate how economists might keep a record of transactions over an interval of time for an individual. This simplest example will illustrate the key ideas about how a record of transactions can shed light on international economic concepts such as trade balances.

8.2 Records of transactions for individuals

8.2.1 Records for Alex

Consider one of our hypothetical and representative individual, say Alex (hereafter A), who is a member of the USA. First we are going to record the value of Alex's various hypothetical transactions over the course of a year. For simplicity, we assume an unrealistically small number of transactions for Alex–just enough to illustrate some important points. We then record the value of Bobby's transactions over the course of the year. Finally we look at the combined transactions for Alex and Bobby–that is, the record of transactions for the nation.

Goods and services purchases and sales For expositional ease, we assume that Alex has very few transactions. To fix ideas, think of Alex as an economics professor who has written a book. Alex regularly sells hundreds of copies of this book to Pat in ROW. To be concrete, assume Alex in year t sells two hundred (200) copies. The value of these books is, at market prices, some amount (measured, for example, in dollars) that we will symbolize as $XP_P^A(t)$. The superscript denotes the person or economic unit selling the good or service and generating a **receipt**, while the subscript denotes the economic unit purchasing the good or service (generating an **expenditure** for them, of course). The number in parenthesis that follows tells us the time period in which the transaction took place. We will consistently use $XP_j^i(t)$ to symbolize the value of a sale of a good or service from individual i to individual j during period t, and the use of "XP" is a mnemonic device to remind us that the sale of some good or service by individual i can be thought of as an "e**xp**ort" by i.

To orient ourselves to our earlier discussion of budget constraints, note that "XP" can always be broken down into the price per unit of the good or service times the number of units sold. For example, in our model of an endowment economy, the sale of an individual's endowment of, say, coffee, would be worth (measured in units of a currency) $P_C \times \overline{C}_i$. In the notation introduced here,

this would be equal to XP_j^i:

$$P_C \times \overline{C}_i = XP_j^i$$

where j would denote whatever individual purchased the coffee (in the endowment model, the identification of the purchaser is unimportant). For our purposes here, the breakdown of the value of an export into price and quantity is not important, but it is important to keep a record of who is the purchaser.

Assume Alex also *purchases* goods from Pat in ROW. We denote the value of these goods as $M_P^A(t)$. Again, the superscripts and subscripts denote that this is a purchase by Alex from Pat, and the subscript denotes the time period during which the transaction takes place. We will consistently symbolize purchases by individual i from individual j during period t by M_j^i. The choice of "M" is a mnemonic device to remind us that the purchase of a good or service by individual i is an "i**m**port" for i.

These two transactions–one a sale of a good from Alex to Pat and one a purchase of a good by Alex from Pat–are both members of a category of transactions, namely purchases or sales of goods and services. When all of the members of this type of transaction–a transaction for a good or service–between Alex and Pat are aggregated, we speak of this as Alex's *bilateral* **trade account** with Pat. If, for all of these transactions, the sum of the value of purchases, i.e., expenditures, is greater than the sum of the value of sales, i.e., receipts, we would say that Alex's bilateral trade balance with Pat is in deficit. And if the sum of the value of sales were greater than the sum of the value of purchases, we would say that Alex's bilateral trade balance with Pat is in surplus. In equivalent language, we could describe these two possibilities by saying Alex had a **trade deficit** or **trade surplus**, respectively, with regards to Pat.

This extremely simple example can illustrate a feature of bilateral trade balances that holds for nations as well as single economic entities such as Alex and Pat. Note that if Alex has an ongoing book-selling opportunity with Pat, it seems reasonable to assume that Alex might engage in these transactions with Pat year after year, and that the value of his "export" to Pat at any date t ,$(XP_P^A(t))$, might regularly exceed the value of his "import" from Pat at any date t, $(M_P^A(t))$. That is, his **bilateral** trade balance with Pat might routinely *not* be zero.

As another more salient example of this general feature of bilateral economic transactions, think about most any individual in the actual economy, say, a professor of economics (Professor CD, for example), at a university (Vanderbilt University, for example). In year t, Professor CD sells teaching and research services to the university. While such services might be thought of as priceless, they do in fact simply command an annual salary that is finite. This transaction would be symbolized as $XP_V^D(t)$. Professor CD also makes a few small purchases from Vanderbilt, such as annual football tickets (Vanderbilt is soon to be a well-known football powerhouse). This transaction would be denoted as $M_V^D(t)$.

Professor CD's bilateral trade balance surplus with Vanderbilt would thus be $XP_V^D(t) - M_V^D(t)$. Realistically, we would expect this surplus to be quite

large, because the bulk of Professor CD's income probably comes from selling his services to Vanderbilt, and his purchases of football tickets are a small portion of his total expenditures in the year. Furthermore, this surplus probably continues year after year, i.e., for t, $t+1, t+2$, and so forth.

What about Professor CD's other bilateral balances? He probably runs continuing trade balance deficits with a variety of other economic entities such as grocery stores, clothing stores, and the like. In this respect, he is like most of the millions of individuals that make up a large commercial economy.

This general feature of bilateral economic transactions between different economic entities (including two countries) arises from the specialization in production and consumption that occurs in a multilateral setting. This means, for example, that despite the rhetoric in the media that surrounds U.S. bilateral trade deficits with China and Japan, such *bilateral deficits would remain a permanent feature even if the U.S. has an overall trade balance surplus vis a vis the entire world.*

DATA, box idea: the U.S.-China balance of trade, focusing on the distinction between value-added and gross balance.

Now consider Alex's other transactions for goods and services, both with his fellow economic unit within his nation and with foreigners. For example, Bobby might be a grocer, so Alex purchases food from Bobby. We would denote the value of these purchases during time period t as $M_B^A(t)$. For simplicity, assume this is Alex's only transaction for goods and services with Bobby during this period. Hence, this would imply that Alex's bilateral trade balance with Bobby would be a deficit: Alex doesn't sell any good or service to Bobby, but buys something. Common experience with the world suggests that this bilateral deficit would be a recurring, permanent feature of Alex's economic relationship with Bobby: Alex will always need and want food, and Bobby doesn't need textbooks.

In two important ways, this relationship of Alex with fellow citizen Bobby is just like the bilateral relationship between Alex and Pat. First, whether the relationship is between fellow citizens or foreigners, we can still analyze these bilateral relationships in terms of surpluses, deficits, or balanced trade. Second, in both cases we expect surpluses and deficits to be a recurring feature of the relationship period after period, just as with the example of Professor CD and Vanderbilt.

Purchases and sales of assets, and net factor payments Now consider transactions in which Alex buys or sells assets. Imagine that Alex takes out a loan, i.e., borrows, an amount of money, from an economic entity in a foreign country, during period t. To be concrete, imagine that Alex borrows money from Charley. We will denote the value of this borrowing as $BF_C^A(t)$, where "BF" is a mnemonic device that signifies "borrowings from." Such a borrowing is thought of as a sale by Alex of an asset, namely an IOU, and thus generates a "payment" this year to Alex from Charley.

Assume Alex also took out a loan, i.e., borrowed, from Charley last year,

and must repay that loan with interest this year. We denote the value of this expenditure as $[1 + r_{t-1}]BF_C^A(t-1)$ The r_{t-1} identifies the interest rate that applies to the loan, with the subscript "$t-1$" indicating that the rate was set when the loan was taken out last year, and the number "$t-1$" in parentheses following BF_C^A identifies the year in which the loan was incurred. The interest component of this expenditure, $r_{t-1} \times BF_C^A(t-1)$, can be thought of as a purchase of the "service" of having the use of the loan from one period to the next. The "repayment of principal" component of this expenditure, $BF_C^A(t-1)$, can be thought of as the purchase of an asset, namely Alex's previously-issued "IOU."

Imagine Alex also makes a loan to Bobby this year (year t). The value of this *expenditure* by Alex is denoted by $LT_B^A(t)$, where "LT" stands for "loan to." Such a loan can be thought of as a purchase of an asset, namely Bobby's IOU.

Alex also receives a repayment of a loan made the previous year to Bobby. This value of this receipt (for Alex) of principle and interest is denoted by $(1 + r_{t-1})LT_B^A(t-1)$. Again, this transaction can be broken into two parts: the interest component which represents sale of the "service" of the use of the money for a year; and the repayment of principal which can be thought of as the sale of an asset, namely Bobby's IOU.

Again, for simplicity assume these two transactions constitute all of Alex's purchases or sales of assets during period t.

Alex's Transactions

Alex's transaction record as a budget constraint These are all of Alex's transactions for the year t. Because we have faithfully recorded all of Alex's transactions, and we have made sure that we attributed a purchase to every payment, it must be that his expenditures (payments made for purchases) equals his receipts (payments *received* from sales). Symbolically, for the stipulated transactions, this is:

$$\begin{aligned} & \overbrace{XP_P^A(t) + (1 + r_{t-1})LT_B^A(t-1) + BF_C^A(t)}^{receipts} \\ = \; & \overbrace{M_P^A(t) + M_B^A(t) + [1 + r_{t-1}]BF_C^A(t-1) + LT_B^A(t)}^{payments} \end{aligned}$$

As a historical record, this is an accounting *identity*: it is true by virtue of definition. We could also have interpreted this as a *planned* budget: in this case, the equality between receipts and payments would reflect that a planned budget makes no sense if planned expenditures don't equal planned receipts. Regardless of interpretation, this accounting statement provides a record of transactions (either planned or historical), carried out over an interval of time, for which expenditures equal receipts.

As noted, economists make use of these accounting statements by classifying the various transactions that are recorded in "*useful*" categories. We put

quotation marks around "useful" to emphasize that the classification categories we use are designed to help us organize thought about interrelations between important variables, and as such are not unique schemes.

With a little algebra, we can rearrange Alex's budget constraint to highlight these categories:

$$\begin{aligned} & \overbrace{XP_P^A(t) - M_P^A(t) - M_B^A(t)}^{TBS_t^A} + \overbrace{r_{t-1} \times LT_B^A(t-1) - r_{t-1} \times BF_C^A(t-1)}^{NFPFO_t^A} \\ = \quad & \overbrace{\left[LT_B^A(t) - LT_B^A(t-1)\right] - \left[BF_C^A(t) - BF_C^A(t-1)\right]}^{\Delta NA_t^A}. \end{aligned}$$

The symbol TBS_t^A stands for "Alex's trade balance surplus for period t," the symbol $NFPFO_t^A$ stands for "*net* factor payments from others at period t," and the symbol ΔNA_t^A stands for "the change in Alex's *net* assets from $t-1$ to t." Thus, in words, we would express Alex's accounting statement as:

> Alex's trade balance surplus (sometimes called *net exports*) plus Alex's net factor payments from others equals the change in Alex's net assets.

Note the distinction between "net" and "gross:" Alex has two "gross" components for net factor payments, namely a payment from Bobby and a payment to Charley. The difference is defined as the "net" factor payments from others. The same is true concerning Alex's net foreign assets: there is a "gross" change in loans made to others, and a "gross" change in borrowings from others, and the difference is defined as the net change. This means that "net" values can be either positive or negative.

We can also display Alex's transactions in tabular form, as in the following chart by transaction partner and by category. The category "G&S" refers to "goods and services per unit of time," the category "NFPFO" refers to "net factor payments from others," the category "ΔNA" refers to "The change in net assets," and the category "Bi. TBS" refers to "bilateral trade balance surplus," and the category "Bi. CAS" refers to "bilateral current account surplus. The bottom row simply aggregates over all transactions within a category. This means the last row entry under "Bi. TBS" and under "Bi. CAS" are, obviously, not bilateral entities, but the overall aggregate for Alex.

	G &S	NFPFO	ΔNA	Bi. TBS	Bi. CAS
B	M_B^A	rLT_B^A	ΔLT_B^A	$-M_B^A$	$rLT_B^A - M_B^A$
C		rBF_C^A	ΔBF_C^A	0	$-rBF_C^A$
P	$XP_P^A,\ M_P^A$			$XP_P^A - M_P^A$	$XP_P^A - M_P^A$
Agg	$\overbrace{XP_P^A - M_B^A - M_P^A}^{TBS}$	$rLT_B^A - rBF_C^A$	$\Delta LT_B^A - \Delta BF_C^A$		$\overbrace{TBS + NFPFO}^{CAS}$

Alex's transactions

The tabular display also emphasizes that there is no reason to expect bilateral balances to be zero.

The language we introduced to describe the various categories of transactions– "net factor payments *from others"* and "changes in net assets"–suggests we can think of Alex as a country by himself. We can. But Alex is in fact a member of a nation, and we are also interested in the nation's accounting statement. To this end, we now consider the records of transactions for the other member of the nation, namely Bobby.

8.2.2 Bobby's transaction record and accounting statement

Purchases or sales of goods and/or services Assume Bobby sells goods to a foreign economic entity. To be concrete, assume Bobby sells his special barbecue sauce to Charley, who operates the Merry Maiden pub in London. The value of these goods (measured in dollars) is denoted as $XP_C^B(t)$. Bobby also purchases Speckled Hen Ale from Charley, the value of which is denoted by $M_C^B(t)$.

Assume Bobby also sells his barbecue sauce to Pat. The value of these goods (measured in dollars) is thus denoted as $XP_P^B(t)$.

Bobby's only other transaction for purchase or sale of goods and services during this period is his aforementioned sale of groceries to Alex. This is a receipt for Bobby, and thus is denoted as $XP_A^B(t)$.

Purchases or sales of assets, and net factor payments Assume Bobby has two (2) transactions involve purchases and sales of assets. As noted, Bobby borrowed from Alex during this time period. The value of this borrowing from Alex would thus be symbolized as $BF_A^B(t)$.

During this time period Bobby also lent money to Pat in ROW, perhaps by extending trade credit. The value of this loan to Pat would be denoted as $LT_P^B(t)$. He also lent money to Pat last period, the value of which is denoted as $LT_P^B(t-1)$.

The only other transactions for Bobby during this period are the factor payments associated with past borrowings and lendings. One of these is the repayment to Alex of the principle and interest of the loan from last period, the value of which is denoted by $[1+r_{t-1}]BF_A^B(t-1)$. The second of these is the payment received from Pat for the principle and interest from last-period's loan, the value of which is denoted as $(1+r_{t-1}) \times LT_P^B(t-1)$.

Bobby's accounting statement for year t is thus:

$$\begin{aligned} & \overbrace{XP_C^B(t) + XP_A^B(t) + XP_P^B(t) + BF_A^B(t) + (1+r_{t-1}) \times LT_P^B(t-1)}^{receipts} \\ = \; & \overbrace{M_C^B(t) + LT_P^B(t) + [1+r_{t-1}]BF_A^B(t-1)}^{payments}. \end{aligned}$$

Bobby's records as a budget constraint As with Alex's statement, Bobby's can be rearranged into a more useful form:

$$\begin{aligned} & \overbrace{XP_C^B(t) + XP_A^B(t) + XP_P^B(t) - M_C^A(t)}^{TBS_t^B} + \overbrace{\left[r_{t-1} \times LT_C^B(t-1)\right] - \left[r_{t-1} \times BF_A^B(t-1)\right]}^{NFPFO_t^B} \\ = & \overbrace{\left[LT_C^B(t) - LT_C^B(t-1)\right] - \left[BF_A^B(t) - BF_A^B(t-1)\right]}^{\Delta NA_t^B}. \end{aligned}$$

As with Alex, we can display Bobby's transactions in tabular form.

	G &S	NFPFO	ΔNA	Bi. TBS	Bi. CAS
A	XP_A^B	rBF_A^B	ΔBF_A^B	XP_A^B	$-rBF_A^B + XP$
C	$XP_C^B,\ M_C^B$			$XP_C^B - M_C^B$	$-rBF_C^A + TB$
P	XP_P^B	rLT_P^B	ΔLT_P^B	XP_P^B	XP_P^B
Agg	$\overbrace{XP_A^B + XP_C^B + XP_P^B - M_C^B}^{TBS}$	$rLT_P^B - rBF_A^B$	$\Delta LT_P^B - \Delta BF_A^B$		$\overbrace{TBS + NFPF}^{CAS}$

Bobby's transactions

Again, the tabular display emphasizes that we should not expect bilateral balances to be zero.

8.3 National or economy-wide budget constraints

For each individual, all this might seem obvious. The virtue of going into this much detail is only seen when we use these individual budget constraints to construct the national transactions record. This is done by adding up all the expenditures of the economic units of Alex and Bobby, the only two members of this hypothetical United States, and setting them equal to the sum of the receipts of these two economic units. The *nations's* transaction record is thus:

$$\begin{aligned} & XP_C^A(t) + (1 + r_{t-1})LT_B^A(t) + BF_C^A(t) + \\ & XP_C^B(t) + XP_A^B(t) + XP_P^B(t) + BF_A^B(t) + (1 + r_{t-1}) \times LT_P^B(t-1) \\ = \ & M_C^A(t) + M_B^A(t) + M_C^A(t) + LT_P^B(t) + LT_B^A(t) \\ & + [1 + r_{t-1}]BF_A^B(t-1) + [1 + r_{t-1}]BF_C^A(t-1) \end{aligned}$$

But some of these entries are the same number: *a transaction between two members of the same country is an expenditure for one but a receipt for the other.* In our example, this is reflected in following equalities:

$$(1 + r_{t-1})LT_B^A(t-1) = [1 + r_{t-1}]BF_A^B(t-1);$$

$$XP_A^B(t) = M_B^A(t);$$
$$BF_A^B(t) = LT_B^A(t);$$

Making use of these equalities, we write the national budget constraint as:

$$\begin{aligned} & XP_P^A(t) + BF_C^A(t) + XP_C^B(t) + XP_P^B(t) + (1 + r_{t-1}) \times LT_P^B(t-1) \\ = M_P^A(t) + M_C^B(t) \qquad & +[1 + r_{t-1}]BF_C^A(t-1) + LT_P^B(t). \end{aligned}$$

Note that the only transactions remaining are those between the economic units of different countries. This is a general feature of economy-wide budget constraints, no matter how many different economic units are involved and no matter how many transactions.

We can rearrange this in a slightly different and more memorable manner:

$$\begin{aligned} & \overbrace{[XP_P^A(t) + XP_C^B(t) + XP_P^B(t)]}^{\text{exports}} - \overbrace{[M_P^A(t) + M_C^B(t)]}^{imports} + \\ & \overbrace{\left[r_{t-1} \times LT_P^B(t-1)\right] - [r_{t-1} \times BF_C^A(t-1)]}^{net \text{ factor } payments} \\ = \quad & \overbrace{\left[LT_P^B(t) - LT_P^B(t-1)\right] - [BF_C^A(t) - BF_C^A(t-1)]}^{\Delta \ net \ foreign \ assets} \end{aligned}$$

In words, this says that the value of exports minus the value of imports plus interest payments made from foreigners to the citizens of the hypothetical U.S. economy (made up of Alex and Bobby) minus interest payments made from U.S. citizens to foreigners equals the the change in the value of aggregate United States citizens' holdings of foreign assets minus the change in foreigners' holdings of United States citizens' assets. If these are planned transactions, we would refer to this as the economy-wide budget constraint.

To reiterate, we have special terminology for the three major components of this economy-wide budget constraint:

1. The value of exports minus the value of imports is known as the **trade balance surplus**. When this is a negative number, it is frequently referred to as the **trade deficit**. When this is a positive number, it is referred to as the **trade surplus.**

2. The trade balance surplus plus the *net* factor payments from abroad that arise from holdings of foreign assets such as bonds, or stocks, or ownership of companies, e.g., Nissan plant in Tennessee, is known as the **current account surplus**.[8] When this is a negative number it is frequently referred to as the **current account deficit.** When this is a positive number, it is referred to as the **current account surplus.**

3. The national budget constraint identity says the current account surplus must equal the change in net foreign assets. This is also known as the **balance of payments** identity.

[8] In reality, net factor payments from factors other than loans are also included in this balance. Most important of these are earnings by workers located in a foreign country that are repatriated to their home countries.

Note that the balances for the nation as a whole are sums of individual balances. This means, for example, that the change in net foreign assets is the *sum* of increases in loans from home-country residents to foreigners *minus* the increase in the sum of loans from foreigners to domestic residents. The point here is that national accounts of the various categories are determined by *individual* decisions. Keep this in mind whenever you read in the newspapers, for example, an article that treats any of these balances as if they are determined by the nation as a monolithic whole.

A tabular display of these transactions for the country as a whole vis a vis the other two countries is also useful:

	UK(Charley)	ROW(Pat)
TBS	$XP_C^B - M_C^B$	$XP_P^A + XP_P^B - M_P^A$
$NFPFO$	$-rBF_C^A$	rLT_P^B
ΔNFA	$-\Delta BF_C^A$	ΔLT_P^B
Bilateral CAS	$XP_C^B - M_C^B - rBF_C^A$	$XP_P^A + XP_P^B - M_P^A + \Delta LT_P^B$

8.4 Implications

We now add some *behavioral* assumptions. First, we start with very "weak" assumptions about restraints on borrowing and lending that don't restrain possible actions very much. These restraints affect the individual and aggregate budget constraints. They still let us derive some implications.

Moving beyond these implications derived from just the budget constraint, we will want to understand the pattern of intertemporal choices made by members of an economy. To do this, we will have to look at the interplay of *preferences* with budget constraints. For arbitrarily large numbers of periods, individuals, and commodities, this would be a decidedly "blackboard **un**friendly" model. Thus, as usual, we will simplify by assuming there are no longer two distinct commodities, such as coffee and tea. The homogenous single good we will consider, though, is both supplied as an endowment and consumed by individuals in each of two time periods. This will be a model of *intertemporal* trade, in contrast to the coffee-tea model of *intratemporal* trade.

8.4.1 Exports (plus inherited wealth) pay for imports

We added some cumbersome notation in order to date the variables in the budget constraints. The payoff for this extra work comes in being able to construct what we might call the *lifetime* economy-wide budget constraint.

We will make this point in as simple as possible a manner, but hope the logic of the simple case provides enough insight so that you believe the claim that there is a general principle that applies to the intertemporal analysis of countries involved in trade. The general principle is that the present discounted value of exports plus the value of inherited wealth must equal the present discounted value of imports.

The specific simple example to illustrate this is a two-period model. In the first period, residents of a country may have existing assets or debts, the sums

of which are denoted as LT_0 and BF_0, respectively. The budget constraint for the country in the first period, denoted as time $t = 1$, is thus:

$$\overbrace{[XP_1 - M_1] + r_0 \times [LT_0 - BF_0]}^{CAS} = \overbrace{LT_1 - LT_0 - [BF_1 - BF_0]}^{\Delta NFA}$$

where XP_t and M_t refer to the value of *aggregate* exports and imports in period t (period one(1) in this period), LT_t is the sum of the loans made from members of the home country to economic units of foreign countries in period t, and BF_t is the sum of the borrowings of members of the home country from members of foreign countries in period t. That is, $[LT_t - BF_t]$ is net foreign assets of the home country at period t, $t = 0, 1$.

Notice we can rearrange this:

$$[LT_1 - BF_1] = (XP_1 - M_1) + (1 + r_0)[LT_0 - BF_0].$$

Now we add some assumptions about behavior.

In the second period, interest payments and principle from first-period loans and borrowings must be repaid. Furthermore, because this is the last period of existence for the country (by assumption), no new loans or borrowings will occur. After all, if everyone is going to die, they wouldn't loan anything to other people, because they wouldn't be around to use the principle and interest that would be repaid, and they would be giving up current consumption.

And no one else would loan such a person anything, because they wouldn't get repaid. As one of the authors' favorite bumper stickers says, "He who dies in debt wins." Sentiments such as these keep prudent lenders from making loans to anyone in their last period of life.

Thus, the period-two budget constraint is given by:

$$XP_2 - M_2 + [(1 + r_1)LT_1 - (1 + r_1)BF_1] = 0.$$

We can rearrange this as:

$$[LT_1 - BF_1] = -\frac{XP_2 - M_2}{1 + r_1}$$

Equating the expression for $[LT_1 - BF_1]$ derived from the first period budget constraint to the expression for $[LT_1 - BF_1]$ derived from the second period budget constraint yields

$$(XP_1 - M_1) + (1 + r_0)[LT_0 - BF_0] = -\frac{XP_2 - M_2}{1 + r_1}.$$

Rearranging to separate exports from imports yields the **lifetime budget constraint**:

$$XP_1 + \frac{XP_2}{1 + r_1} + (1 + r_0)[LT_0 - BF_0] = M_1 + \frac{M_2}{1 + r_1}.$$

We denote this the lifetime budge constraint because it can be interpreted as a statement that says:

> The present discounted value of lifetime receipts equals the present discounted value of lifetime imports.

Consider first the case in which $[LT_0 - BF_0] = 0$, that is, the case in which there is no legacy of net foreign assets. In this case, the lifetime budget constraint simply says that the present discounted value of exports equals the present discounted value of imports. In this sense we can say that "exports pay for imports" even though at any moment in time a nation's value of exports can be less than or greater than its value of imports.

Now let us consider the case in which we start with non-zero net foreign assets. Now, we must amend our description of the lifetime budget constraint to say "the present value of exports plus the value of inherited net foreign assets equals the present value of imports."

The logic of this exercise extends to as many time periods as we would like: three, four, five, two thousand, three gazillion, and more.

This exercise has two important purposes. First, it is important for our interpretation of the analysis of "real" trade, i.e., the POW model of trade within a period, because it lets us put in perspective the results about patterns, effects, and gains from trade that are derived from simple models in which the trade balance is always zero. The results are robust to real-world conditions of non-zero trade balances because we can reinterpret the simple models as applying to the "lifetime" of an economy.

Second, the exercise let's us *begin* to organize thought about current events. Let us see what the exercise implies about, for example, the U.S. situation in 2006. In 2006, U.S. net foreign assets were negative, and the current value of exports was less than the current value of imports, i.e., both the trade balance and the current account balance were negative (in deficit). The logic of the lifetime budget constraint implies that *at some point in the future* the U.S. will run a *trade balance surplus*.[9] That is, trade deficits are inherently self-correcting.

This is not to deny that there are analyses of the U.S. deficits that make a case for concern by policymakers over the size of these deficits. But these analyses emphasize potential problems with costs of rapid adjustments if the change from deficit to surplus occurs rapidly.

9 Summary and conclusions

Our brief foray into macroeconomics helps us understand what problems are not addressed directly by our real trade model, and sketches out the bare model of money demand, supply, and equilibrium that allows us to understand the link between real trade and monetary trade.

[9] We should note that there is some controversy over whether the U.S. in aggregate should be treated as a net debtor, because net factor payments from abroad are actually positive for the U.S. while "book values" of net assets are negative. The controversy arises because it is difficult to know why a net debtor receives more income from the net creditor than the net creditor receives from the net debtor.

It also introduces the accounting identities that allow us to interpret the static, basic real trade model in ways that give us confidence that the implications of these models are robust even in a world of persistent trade balance imbalances.

Finally, this accounting framework exposes some common fallacies about trade and current account balances. In particular, in a multilateral world bilateral balances are inherently not very interesting: we should expect to see continuing persistent bilateral deficits and surpluses even if the overall balances are zero. And trade and current account deficits are not inherently bad, but can simply reflect sensible intertemporal choices made by individuals within a country.

13187 words