Current Account Adjustment in a Model with Multiple Tradable Sectors and Labor Market Rigidities

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July, 2009

Abstract

The classic theory of an intertemporal approach to current account generates too much current account movement relative to the data (the *level puzzle*), and is silent on why a labor-abundant country often exports capital to a capital-abundant country (the *sign puzzle*). This paper introduces a model with multiple tradable sectors and rigidities in the domestic labor market. It allows for a change in domestic industrial composition (intra-temporal trade) as a new channel for an economy to adjust to shocks without necessarily going through its current account (intertemporal trade), and therefore helps to explain the *level puzzle*. The degree of labor market rigidities pins down the relative reliance on changes in current account versus industrial composition as adjustment channels. Since a labor-abundant (capital-abundant) economy is more likely to experience a favorable productivity shock to its labor-intensive (capital-intensive) sector, the new model can rationalize capital exports from a poor to a rich economy, and therefore provides a new explanation for the *sign puzzle*.

Keywords: Current Account, Industrial Structure, Labor Market Rigidity

JEL Classification Numbers: F3 and F4

*University of Oklahoma, E-mail: jdju@ou.edu. **Columbia Business School and NBER, E-mail: shangjin.wei@columbia.edu, Web page: www.nber.org/~wei. The paper extends the theory part of the earlier version of this paper, "Current Account Adjustment: Some New Theory and Evidence." We significantly revise the model and add discussions in aggregate technology shocks and sector-specific shocks in this version. We thank Joshua Aizenman, Rudolfs Bems, Luca Dedola, Mick Deveraux, Marcel Fratzscher, Gordon Hanson, Jean Imbs, Olivier Jeanne, Aart Kraay, Nuno Limao, Akito Matsumoto, Jonathan Ostry, David Parsley, Ken Rogoff, Eric van Wincoop and seminar participants at Northwestern University, University of Lausanne, Graduate Institute for International Studies in Geneva, the IMF, the European Central Bank, SED Annual Meeting 2008, and CEPR Conference on International Macroeconomics and Finance, Paris 2008, for helpful discussions and suggestions, and Xuebing Yang for research assistance.

Contents

1 Introduction

This paper is motivated by two puzzles associated with current accounts and international capital flows. First, the intertemporal approach to current account, developed in seminal work by Sachs (1981, 1982) and Svesson and Razin (1983) and codified in a graduate-level textbook by Obstfeld and Rogoff (1996), predicts more frequent current account adjustments than in the data (see, for example, Sheffrin and Woo, 1990; Otto, 1992; Ghosh, 1995; Obstfeld and Rogoff, 1996; and Hussein and de Melo, 1999). The Feldstein and Horioka puzzle (1980) that a country's saving and investment are highly correlated is another manifestation of this. Tesar (1991), Backus and Smith (1993), Backus, Kehoe and Kydland (1992, 1994), and Glick and Rogoff (1995) show, from different angles, that the actual current account in the data is less variable than in the model. We label this as a "*level puzzle.*" Second, while the theory predicts that capital-abundant (i.e., high-income) countries export capital (i.e., to run a current account surplus) and capital-scarce (i.e., low-income) countries import capital (i.e., to run a current account deficit), the actual patterns deviate from the prediction. For example, several high-income countries (e.g., the United States) run a persistent current account deficit, and several low-income countries (e.g., China) run a current account surplus. We call this a "*sign puzzle.*" The Lucas paradox – there appears to be an insufficient amount of international capital that flows from rich to poor countries – is another manifestation of this *puzzle.*

In this paper, we propose a model with multiple tradable sectors and incorporate insights from the theory of international trade (in goods) to the discussion of current account. In this setup, a change in the composition of the tradable sectors in the output and goods trade is an alternative to current account adjustment. This generalization has profound consequences. First, even with a large, temporary, and country-specific shock to either productivity, preference, or endowment, the current account response may be small. Thus, it provides a possible explanation for the *level puzzle*. The intuition behind this apparently major departure from the classic exposition of the intertemporal approach to current account can be understood by appealing to the Heckscher-Ohlin theory of goods trade. Consider a shock (e.g., a temporary reduction in capital endowment, a decrease in discount rate, or an increase in labor-augmenting productivity) that would have produced a desire to import capital in the classic intertemporal trade model with one-tradeable-sector. Instead of importing capital directly (i.e., adjusting the current account), a country can import capital indirectly by importing more of the capital-intensive product and at the same time exporting more of the labor-intensive product (i.e., adjusting the composition of the goods trade). In other words, the capital flow that would have taken place is substituted by a change in the composition of goods trade.[1] A change in the sectoral composition of industrial output changes domestic investment demand, and therefore achieves indirectly the objective of altering domestic interest rate without having actual capital flows across borders.

Second, by having multiple tradeable sectors, the model can accommodate empirically important sector-biased productivity improvement. It is through this channel that the model provides a new potential explanation for the *sign puzzle*. It has been noted that a country's productivity changes are often not uniform across sectors but instead favor its comparative-advantage sectors. As an example, for a labor-abundant economy like China, technological improvement more often takes place in labor-intensive sectors. On the other hand, for a capital-abundant economy like the United States, productivity improvement concentrates in capital-intensive sectors.[2] Sector-biased

[1] The point on potential substitution between international trade and capital mobility is pioneered by Mundell (1957), and discussed by Jones and Neary (1984), Wong (1986), and Neary (1995), among many others.

[2] Biased technological improvement was first discussed by Hicks (1953), who suggested that the technological improvement tends to be export-biased if the terms of trade effects were negligible. Empirically, Harrigan (1997) finds that both sectoral levels of technology and factor supplies are important determinants of international specialization. Using his estimation, for two countries with similar factor endowments, if one exports Apparel but another exports Paper, it must be the case that the country which exports Apparel has higher TFP in this sector. Fadinger and Fleiss (2008) show that productivity differences between rich and poor countries are systematically larger in skill intensive sectors and sectors that are more intensive in R&D. This again is consistent with the idea that productivity improvement is likely to concentrate in a country's comparative-advantage

productivity changes cannot be discussed, by construction, in a classic intertemporal model with a single tradeable sector. In our model, this type of sector-biased productivity shocks would reduce the demand for capital in a labor-abundant country but increase the demand for capital in a capital-abundant country. This would result in a capital scarce economy to export capital and a capital rich economy to import capital. While this is not the only explanation for the *sign puzzle* or the Lucas paradox, it is an alternative one that does not rely on assuming cross-country differences in aggregate human capital or financial development.

Besides addressing the level and sign puzzles associated with current account, another potentially important contribution of the paper is to build a linkage between domestic labor market rigidities and current account adjustment. With the introduction of a new channel to adjust to shocks (through a change in the industrial composition), a new complication arises: there are infinite combinations of changes in current account and industrial structure that can constitute an equilibrium. Hence, the exact amount of capital flows and goods trade is indeterminate. We introduce labor market rigidities to pin down a unique combination of a change in the current account and a change in the domestic industrial structure. The exact amount of current account adjustment depends in part on the degree of domestic labor market rigidity.

It is useful to compare our approach with the existing literature that also addresses either the level puzzle or the sign puzzle or both. Obstfeld (1986), Mendoza (1991) and Baxter and Crucini (1993) show that persistent productivity changes can produce a positive correlation between saving and investment in a dynamic general equilibrium model with perfect capital mobility but one tradeable sector. In our model, we can explain the level puzzle without persistent productivity changes. Backus, Kehoe, and Kydland (1992) show that trade frictions lower the variability of investment and net exports. Fernandez de Cordoba and Kehoe (2000) incorporate frictions in the

sectors.

domestic labor market that impede resource reallocation between the non-tradable and tradable sectors. In their model, the greater the labor market frictions, the smaller the current account change. In contrast, in our model, an increase in labor market frictions could augment rather than dampen the current account change. Corsetti, Dedola, and Leduc (2008) show that, with incomplete asset markets, strong wealth effects in response to shocks raise the demand for domestic goods above supply and therefore change the prediction for capital flows. Raffo (2008) argues that a class of preferences that embeds home production helps to explain countercyclical net exports. While the IRBC literature does not focus on the linkage between composition of goods trade and capital flow, our model is close to Cunat and Maffezzoli (2004) who introduce Heckscher-Ohlin trade features into a DSGE model, and is closest in spirit to Cole and Obstfeld (1991) who show that terms of trade responses alone may provide perfect insurance against output shocks so that gains from international portfolio diversification is small. To the best of our knowledge, the effect of sector-specific shocks on current account has not been studied in the literature. In terms of the *sign puzzle,* Caballero, Farhi, and Gourinchas (2008), Mendoza, Quadrini, and Rios-Rull (2007), and Ju and Wei (2007b) focus on differential quality of domestic financial systems as a source of the global imbalances. This paper shows that sector-specific technological improvements and trade liberalizations could also be sources of global imbalances.[3]

There is a small literature on the effect of trade policy reforms on current account. Ostra and Rose (1992), and Ju, Wu, and Zeng (2009) show that the effect of tariff reductions on trade balances is ambiguous. Our model provides a natural explanation: trade policy reforms often take the form of reducing trade barriers in

[3] Following Ju and Wei (2007), Jin (2008) also discusses potential substitution between a change in industrial composition and a change in current account, in a DSGE setup with calibrations. Like in Ju and Wei (2007), she also considers a labor-augmenting productivity change (without labor market rigidities) and argue that it can deliver capital flows from a labor abundant country to a capital abundant country. In our model, we show that a symmetric productivity shock across sectors does not generate such patterns of capital flows. However, with sector-biased shocks, something not discussed in Jin (2008) but empirically relevant, we can generate such patterns of capital flows.

capital intensive sectors in a labor-abundant country (but of reducing trade barriers in labor-intensive sectors in a capital-abundant country). Such changes would reduce the domestic output of capital intensive goods in a labor-abundant country, causing it to export capital or generate a current account surplus.[4] The opposite would happen to trade reforms in a capital-abundant country. When mixing both types of countries in a sample, it is not surprising to find an ambiguous effect of trade reforms on current account.

This paper is related to the literature on dynamic Heckscher-Ohlin models pioneered by Oniki and Uzawa (1965), Bardhan (1965), Stiglitz (1970), and Deardorff and Hanson (1978). Other contributions in recent years include Chen (1992), Baxter (1992), Nishimura and Shimomura (2002), Bond, Trask and Wang (2003), and Bajona and Kehoe (2006). Most closely related to our paper is one by Ventura (1997), which studies trade and growth in a model with one final good, two intermediate goods, and labor-augmenting technology. This literature tends to focus on income convergence across countries–rather than current account adjustment (Indeed, a balanced trade is typically assumed). In terms of the way we introduce labor market rigidities, our paper is also related to specific factor models in the trade literature by Jones (1971), Mayer (1974), Mussa (1974), and Neary (1978 and 1995).

We organize the rest of the paper in the following way. Section 2 sets up the overlapping-generations model with multiple tradable sectors. Section 3 studies a frictionless small open economy. Section 4 introduces the labor market rigidity to the model. The labor market institution is parameterized in such a way that the specific-factor model and the Heckscher-Ohlin model are special cases of the formulation. Section 5 concludes and points to directions for future research. A set of appendices contains proofs to propositions in the text together with some

[4] China joined the World Trade Organization in 2001, with extensive reductions in trade barriers along the way, mostly in capital-intensive sectors. Note that the average current account surplus in China was 7.6 billion dollars from 1982 to 2001, but jumped to 156 billion dollars from 2002 to 2007. While many explanations have been proposed, the current paper provides a new angle by focusing on the effect of productivity improvements in the labor-intensive sectors and tariff reductions in the capital-intensive sectors.

extensions.

2 An Overlapping-Generations, Multi-Sector Model

We use an overlapping-generations model to illustrate the idea, and start with a case with both trade and financial autarky and no labor market rigidities. Let L_t denote the number of identical individuals born in period t. There is no population growth; thus $L_t = L_{t-1} = L$. Each individual is assumed to live for two periods, young and old. When an individual is young, she supplies one unit of labor and divides the labor income between consumption and saving. When she is old, she doesn't work and consumes the saving (principle plus interest).

The consumption side of the model is standard. Let C_t^y and C_t^o be the consumption in period t of young and old individuals, respectively. The lifetime utility of a representative individual born at t, U_t, is defined as

$$U_t = u(C_t^y) + \beta u(C_{t+1}^o),\ 0 < \beta < 1 \tag{1}$$

where β is a discount factor. Let w_t be the wage rate per unit of labor in period t, and r_{t+1} the interest rate from period t to $t+1$. She maximizes utility (1) subject to the following intertemporal budget constraint:

$$C_t^y + \frac{C_{t+1}^o}{1 + r_{t+1}} = w_t \tag{2}$$

The first order condition is:

$$\frac{\beta u'(C_{t+1}^o)}{u'(C_t^y)} = \frac{1}{1 + r_{t+1}} \tag{3}$$

which is a standard intertemporal Euler equation. (2) and (3) together solve for C_t^y and C_{t+1}^o as functions of (w_t, r_{t+1}, β). An individual's savings at the end of period t is $s(w_t, r_{t+1}, \beta) = w_t - C_t^y(w_t, r_{t+1}, \beta)$. Thus, the economy-wide total savings in period t is given by

$$S_t(w_t, r_{t+1}, \beta, L) = [w_t - C_t^y(w_t, r_{t+1}, \beta)]\, L \tag{4}$$

Since $C_t^y(w_t, r_{t+1}, \beta)$ decreases as r_{t+1} increases, $S_t(w_t, r_{t+1}, \beta, L_t)$ is an increasing function of r_{t+1}.

2.1 Production

The production side of the model features two intermediate goods and a final good. Both labor and capital are used to produce two intermediate goods X_{1t} and X_{2t}, which are not consumed directly. The final good, used for both consumption and investment, is produced by two intermediate goods, and is taken as a numeraire with price equal to 1. The economy's endowment in period t consists of labor L, and capital stock K_t. In equilibrium, $K_t = S_{t-1}$. Our model setup is close to Ventura (1997) with one crucial difference. While international capital flows (or intertemporal trade) are prohibited by assumption in his model, we not only allow for intertemporal trade but make it a central focus of the discussion.

The market is perfectly competitive. The production function for the final good is $Y_t = G(X_{1t}, X_{2t})$. The production function for intermediate good $i (= 1, 2)$ is $X_{it} = f_i(A_{it}L_{it}, K_{it})$ where A_{it} measures labor productivity in sector i. $H_{it} = A_{it}L_{it}$ can be understood as *effective labor.*[5] All production functions are assumed to be homogeneous of degree one. We assume no depreciation of capital for simplicity. The unit cost function for X_{it} is

$$\begin{aligned}
\phi_i(\frac{w_t}{A_{it}}, r_t) &= \min\{w_t L_{it} + r_t K_{it} \mid f_i(A_{it}L_{it}, K_{it}) \geq 1\} \\
&= \min\{\left(\frac{w_t}{A_{it}}\right) H_{it} + r_t K_t \mid f_i(H_{it}, K_{it}) \geq 1\} \qquad (5)
\end{aligned}$$

[5] While most of the discussion of a productivity shock is about a labor-augmenting technical change, the case of a Hicks-neutral productivity change is discussed at the end of section 4.

We assume that $A_{1t} = A_{2t} = A_t$ in this section and denote $q_t = w_t/A_{it}$ as the wage rate for one unit of effective labor. The case of $A_{1t} \neq A_{2t}$ will be discussed in later sections.

Free entry ensures zero profit for the intermediate goods producers. If the country's endowment is within the diversification cone, both intermediate goods are produced. In period $t+1$ we have:

$$p_{1,t+1} = \phi_1(q_{t+1}, r_{t+1}) \text{ and } p_{2,t+1} = \phi_2(q_{t+1}, r_{t+1}) \tag{6}$$

where p_i is the price of intermediate good i. The full employment conditions for labor and capital, respectively, are

$$a_{1L,t+1}X_{1,t+1} + a_{2L,t+1}X_{2,t+1} = A_{t+1}L = H_{t+1} \tag{7}$$

$$a_{1K,t+1}X_{1,t+1} + a_{2K,t+1}X_{2,t+1} = K_{t+1} \tag{8}$$

where

$$a_{iL,t+1} = \frac{\partial \phi_i(q_{t+1}, r_{t+1})}{\partial q_{t+1}}, \text{ and } a_{iK,t+1} = \frac{\partial \phi_i(q_{t+1}, r_{t+1})}{\partial r_{t+1}} \tag{9}$$

are effective labor and capital usages per unit of production at $t+1$, respectively. The profit maximization for final good producers requires that

$$p_{1,t+1} = \frac{\partial G(X_{1,t+1}, X_{2,t+1})}{\partial X_{1,t+1}} \text{ and } p_{2,t+1} = \frac{\partial G(X_{1,t+1}, X_{2,t+1})}{\partial X_{2,t+1}} \tag{10}$$

which implies

$$G(X_{1,t+1}, X_{2,t+1}) = p_{1,t+1}X_{1,t+1} + p_{2,t+1}X_{2,t+1} \tag{11}$$

$$= w_{t+1}L_{t+1} + r_{t+1}K_{t+1} \tag{12}$$

Equation (11) is a consequence of $G(.)$ being homogeneous of degree one and implies zero profit for the final good producer. Equation (12) reflects zero profit for the intermediate good producers, and ensures that the supply equals the demand in the final good market.

Equations (6)- (10) are a set of standard equations from a Heckscher-Ohlin (HO) framework. Therefore, all standard results from the classic HO model hold. In particular, for a given vector of product prices $(p_{1,t+1}, p_{2,t+1})$, factor prices (q_{t+1}, r_{t+1}) are uniquely determined by (6). This means that Samuelson's factor price equalization theorem holds in the model: If the product prices $(p_{1,t+1}, p_{2,t+1})$ are the same across countries, the effective wage rate, q_{t+1}, and the interest rate, r_{t+1}, must also be equal across countries. Given the factor prices, the endowment vector (L_{t+1}, K_{t+1}) then determines the output vector $(X_{1,t+1}, X_{2,t+1})$ through equations (7) and (8). Finally, product prices $(p_{1,t+1}, p_{2,t+1})$ and sectoral output are also linked by the market clearing conditions (10) for the products.

Without loss of generality, we assume that intermediate good 1, X_{1t}, is labor intensive, while X_{2t} is capital intensive. If K_{t+1} increases, the Rybczynski theorem implies that the output of the capital intensive sector $X_{2,t+1}$ expands, while the output of the labor intensive sector $X_{1,t+1}$ shrinks. Thus the market price of $X_{2,t+1}$, $p_{2,t+1}$, declines, while $p_{1,t+1}$ increases. Using the Stolper-Samuelson theorem, the return to capital, r_{t+1}, declines, while the effective wage rate q_{t+1} increases. Thus, $r(A_{t+1}L_{t+1}, K_{t+1})$ as a solution to the above system is a decreasing function of K_{t+1}. The inverse function of this,

$$K_{t+1} = I(A_{t+1}L_{t+1}, r_{t+1}) = r^{-1}(A_{t+1}L_{t+1}, r_{t+1}) \tag{13}$$

defines an economy-wide investment function.

2.2 Response Patterns to Shocks under Trade and Financial Autarky

We consider five types of shocks: (a) An economy-wide labor productivity shock, (b) a shock to the representative agent's discount factor, (c) a shock to the economy-wide supply of labor or capital, (d) a sector-specific productivity shock, and (e) a reduction in tariff. As it will become clear later, an increase in economy-wide labor productivity, by increasing the effective supply of labor relative to capital, generates the exact same current account response as a shock that makes agents less patient, or a shock that reduces the economy's supply of capital, or a shock that increases labor supply. For this reason, we can combine Types (a), (b) and (c) shocks, and with a slight abuse of terminology, call them "endowment shocks." Likewise, since a reduction in tariff favors the sector that represents the economy's comparative advantage at the expense of the other sector, it generates the same current account response as a sector-specific productivity shock that favors the comparative-advantage sector. For this reason, we can combine Types (d) and (e) shocks, and call them "sector-specific shocks".

Our model departs from the static HO model by making capital, K_{t+1}, endogenous and equal to the savings in the previous period. That is,

$$K_{t+1} = I(A_{t+1}L_{t+1}, r_{t+1}) = S_t(w_t, r_{t+1}, \beta, L_t) \tag{14}$$

The equilibrium interest rate in period $t+1$, r_{t+1} is determined by equation (14). This can be represented by a Metzler diagram in Figure 1 that has saving and investment on the horizontal axis and the interest rate on the vertical axis. The upward-sloping SS curve represents the saving function (4) (the supply for capital), while the downward-sloping II curve represents the investment function (13) (the demand for capital). The equilibrium investment K_{t+1} and the interest rate r_{t+1} are determined by the intersection between the SS and II curves. We briefly consider two cases of comparative statics under autarky, namely, (a) an increase in the capital supply in period $t+1$, and (b) an increase in labor productivity in period $t+1$ and in period t, respectively. The objective is to show that our model under autarky behaves in the same way as the textbook model of current account with one tradable sector.

There is nothing unusual so far.

2.2.1 A Shock to Capital Supply in Period $t+1$

Consider an exogenous increase in the capital supply in period $t+1$, possibly due to an infusion of international aid, or an increase in the discount factor β in period t (so that an individual becomes more patient and prefer to postpone consumption in period t). Therefore, in Figure 1, the saving curve SS shifts out, while the investment curve II remains unchanged. The equilibrium moves from E to C and r_{t+1} declines.

2.2.2 A Shock to Economy-Wide Labor Productivity

Consider first an increase in A_{t+1}. This produces both direct and indirect effects on wage rate. On one hand, for a given q_{t+1}, an increase in A_{t+1} raises w_{t+1} proportionally since $w_{t+1} = A_{t+1}q_{t+1}$. On the other hand, by raising effective labor units, $H_{t+1} = A_{t+1}L_{t+1}$, it reduces effective wage rate q_{t+1}, which in turn indirectly puts downward pressure on wage rate w_{t+1}. Under some standard stability assumptions which we assume to hold, the direct effect dominates indirect effect so that an increase in A_{t+1} raises wage rate w_{t+1}. The effect of the increase in A_{t+1} on r_{t+1} can be analyzed in Figure 1. The increase in A_{t+1} shifts out the investment demand curve II (equation (13)) in Figure 1. Under our setup, as the increase in A_{t+1} has no effect on the wage income in period t, the saving curve SS does not move. As the result, r_{t+1} increases.

Now consider an improvement in labor productivity in period t, A_t. As this raises the labor income $w_t = A_t q_t$ in period t, the saving curve SS shifts out, while the investment curve II in period $t+1$ is not affected. As a result, r_{t+1} declines.

3 A Frictionless Small Open-Economy

Let us now consider the case of a small open economy which takes world prices as given, and can engage in both intra-temporal and intertemporal trade. Intra-temporal trade (goods trade) takes place when a country exports the (intermediate) good of its comparative advantage and imports the other (intermediate) good, whereas intertemporal trade (capital flow) takes place when a country lends capital (or runs a current account surplus) to another country in one period and collects the capital back with interest (or runs a current account deficit) in a future period. Our objective is to demonstrate how our setup, through an interaction between goods trade and capital flows, may explain both the *level puzzle* of capital flows (when an economy faces a shock to its endowment, aggregate productivity or discount rate), and the *sign puzzle* (when an economy faces a sector-specific shock). All shocks are assumed to hit the economy in period $t+1$ for simplicity. An appendix discusses a large country case in which the product prices are endogenous.

3.1 The Current Account Balance and Capital Flows

Let $\widehat{X}_{i,t}$ be the usage of intermediate good i by the final good producer. The output of final good in the open economy equals total factor income. That is,

$$Y_t = G(\widehat{X}_{1,t}, \widehat{X}_{2,t}) = w_t L_t + r_t K_t \tag{15}$$

where K_t is the total capital usage in the home country. K_t is the sum of domestic saving from the last period and the amount of capital inflow in this period. In other words,

$$K_{t+1} = S_t(w_t, r_{t+1}, \beta, L) + K_{t+1}^{inflow} \tag{16}$$

where K_{t+1}^{inflow} is the amount of capital inflow in period $t+1$. $K_{t+1}^{inflow} > 0$ represents capital inflow, while $K_{t+1}^{inflow} < 0$ represents capital outflow.

The zero profit condition for the final good producer implies that $p_{1,t}\widehat{X}_{1,t} + p_{2,t}\widehat{X}_{2,t} = w_t L_t + r_t K_t$. Recall that L_t and K_t are used to produce intermediate goods $X_{1,t}$ and $X_{2,t}$ in the country. Therefore, the intra-temporal trade is balanced since

$$\begin{aligned} p_{1,t}X_{1,t} + p_{2,t}X_{2,t} &= w_t L_t + r_t K_t = p_{1,t}\widehat{X}_{1,t} + p_{2,t}\widehat{X}_{2,t} \Leftrightarrow && (17) \\ p_{1,t}\left(\widehat{X}_{1,t} - X_{1,t}\right) &= p_{2,t}\left(X_{2,t} - \widehat{X}_{2,t}\right) && (18) \end{aligned}$$

where the first equality in (17) is due to the zero profit condition for the intermediate good producers, while the second equality in (17) is due to the zero profit condition for the final good producer. The equality (18) indicates that the value of imports in good 1 equals the value of exports in good 2.

Let B_t be the value of the country's net foreign asset at the end of period $t-1$. The current account balance over period t is defined as $CA_t = B_{t+1} - B_t$. As intra-temporal trade is balanced, the representative consumer's budget constraint in period t is:

$$CA_t = B_{t+1} - B_t = Y_t^T - C_t - I_t + r_t B_t \tag{19}$$

where

$$\begin{aligned} Y_t^T &= Y_t + (K_t + B_t), \; C_t = C_t^y L_t + C_t^o L_{t-1}, \\ C_t^o L_{t-1} &= (1 + r_t)(K_t + B_t), \text{ and } K_{t+1} = I_t && (20) \end{aligned}$$

The total output in period t, Y_t^T, is the sum of final product produced in period t and the asset owned by old individuals; C_t is the sum of consumptions by young and old in period t; the consumption of old, $C_t^o L_{t-1} = (1 + r_t)(K_t + B_t)$; $K_{t+1} = I_t$ since K_t is all consumed in period $t+1$. Substituting (15) and (20) into (19), we have

$$CA_t = (w_t - C_t^y)\, L_t - K_{t+1} = S_t(w_t, r_{t+1}, \beta, L) - K_{t+1} = -K_{t+1}^{inflow}$$

3.2 Endowment Shocks

For comparison, we first discuss how our model works if intra-temporal trade in the intermediate goods is artificially banned (e.g., through prohibitive tariffs). Assume that the home country is hit by a shock that increases the supplies of capital $t+1$. All foreign variables are denoted by a "*". The saving curve at home now becomes $S_t(w_t, r_{t+1}, \beta, L_t) + \varepsilon = K_{t+1}$ where $\varepsilon > 0$ is the positive shock of capital supply due to an infusion of international aid (or the increase in time preference β in period t). The saving curve in period $t+1$ shifts out from SS to $S'S'$, while the investment curve II remains unchanged in Figure 1. The post-shock home autarky interest rate, r'_{t+1}, is at point C and less than the world interest rate r^*. Thus, if only intertemporal trade is allowed, the home country would run a current account surplus in period t, and directly export EG amount of capital in Figure 1. An improvement in the future technology A_{t+1}, on the other hand, would shift the investment curve II out to $I''I''$ while leave the saving curve SS unchanged. Thus, the domestic interest rate would increase to r''_{t+1} in autarky and the country would import EF amount of capital if only intertemporal trade is allowed. These results resemble those in Obstfeld and Rogoff (1996).

Suppose we now allow for free intra-temporal trade in intermediate goods, but ban intertemporal trade (i.e., through strict capital controls). Free trade in the intermediate goods equalizes their product prices across countries in every period. That is, $p_{i,t+1} = p^*_{i,t+1}$. Under the standard assumption that production function $f_i(.)$ is the same for all countries, rewriting equation (6) and the counterpart in foreign country, we have:

$$\begin{aligned} p_{1,t+1} &= \phi_1(q_{t+1}, r_{t+1}) \text{ and } p_{2,t+1} = \phi_2(q_{t+1}, r_{t+1}) \\ p^*_{1,t+1} &= \phi_1(q^*_{t+1}, r^*_{t+1}) \text{ and } p^*_{2,t+1} = \phi_2(q^*_{t+1}, r^*_{t+1}) \end{aligned} \tag{21}$$

which implies that factor prices at home and abroad must be equal in every period

$$q_{t+1} = q^*_{t+1} \text{ and } r_{t+1} = r^*_{t+1} \tag{22}$$

Since neither β nor K nor L appear in the above system, any shock to the discount factor or the supply of capital or the supply of labor would not affect the conclusion that domestic interest rate is equal to foreign interest rate. Moreover, the only place where A_{t+1} appears is in q_{t+1}. So a shock to A_{t+1} would alter the wage rate proportionately, but would not otherwise disturb domestic interest rate. Consider now opening up the economy for international capital flows. With equal interest rates in both countries both before or after any of these shocks, there is no incentive for capital to move across the border. Thus a major prediction of the classic intertemporal trade theory - that current account responds to temporary shocks - disappears.

The underlying reason for the difference between our setup and that in Obstfeld and Rogoff (1996) is that an extra channel for adjustment to shocks - through intra-temporal trade in the intermediate goods - has been opened up. In particular, what hides behind factor price equalization theorem (and hence non current account adjustment after any type of endowment shock) is that the relative output of the two sectors, and hence, the total demand for capital in the economy, do adjust in response to these shocks. In other words, in response to a shock that normally would have generated a capital outflow under the classic intertemporal trade model, the home country can instead increase the production and export of the capital intensive intermediate good, but increase the imports of (and reduce the production of) labor intensive good. While there is no change in current account, capital is exported indirectly.

This idea can be illustrated by the Metzler diagram shown in Figure 1. First we consider a capital supply shock that shifts out the home saving curve from SS to $S'S'$. Let I^eI^e be the investment curve at home under free goods trade. As Home produces and exports more capital intensive good, the home investment curve I^eI^e in Figure 1 shifts out. The intra-temporal trade moves the domestic equilibrium from C to G. Instead of directly exporting EG amount of capital, now the home country uses all of domestic supply of capital K'_{t+1} to produce more and export capital intensive good, and the interest rate after free intra-temporal trade is restored back to the level of the world interest rate, r^*.

On the other hand, when A_{t+1} increases to A'_{t+1}, the effective labor supply increases from $A_{t+1}L_{t+1}$ to $A'_{t+1}L_{t+1}$ in period $t+1$. When goods trade is allowed, the home country will produce more labor intensive good and less capital intensive good; as a result, the investment curve shifts back to II. The interest rate r_{t+1} again is restored to r^* due to factor price equalization. The output now is determined by equations (7) and (8) but replacing A_{t+1} by A'_{t+1}. Instead of directly importing EF amount of capital, the home country now produces less and imports capital intensive good. The intra-temporal trade moves the domestic equilibrium in Figure 1 from H to E. The following proposition summarizes our discussion:

Proposition 1 *For a frictionless small open economy with free trade in goods, it can adjust to an endowment shock - a shock to β or A_{t+1} or K or L - entirely by altering the relative size of the two sectors and the composition of goods trade without changing its current account.*

3.3 Multiple Equilibria

In response to an endowment shock, while zero current account change is an equilibrium, it is not a unique one. To see this, note that the equilibrium conditions are summarized by equation (21) and the full employment conditions for labor and capital

$$a_{1L,t+1}X_{1,t+1} + a_{2L,t+1}X_{2,t+1} = A_{t+1}L = H_{t+1} \quad (23)$$

$$a_{1K,t+1}X_{1,t+1} + a_{2K,t+1}X_{2,t+1} = K_{t+1} = S_t(w_t, r_{t+1}, \beta, L) + K_{t+1}^{inflow} \quad (24)$$

As factor prices (q_{t+1}, r_{t+1}) are determined by the world product prices $\left(p_{1,t+1}^*, p_{2,t+1}^*\right)$, a marginal change in K_{t+1}^{inflow} has no effect on consumer's lifetime utility. Three endogenous variables, $X_{1,t+1}$, $X_{2,t+1}$, and K_{t+1}^{inflow}, are solved by two equations (23) and (24). Therefore, we have multiple equilibria in the system.

A graphical representation in Figure 2 is used to illustrate the above analysis. O represents the origin for the home country. Vectors $OX_1 = (a_{1L}, a_{1K})\,X_1$ and $OX_2 = (a_{2L}, a_{2K})\,X_2$ represent the employment of capital and labor in intermediate sectors 1 and 2 in the equilibrium. Therefore, X_1OX_2 is the diversification cone in which the home country produces both intermediate goods. Let $E = (A_{t+1}L, K_{t+1})$ be the factor endowment of the home country without capital flow. The full employment conditions in home country, (23) and (24), determine the domestic employment of labor and capital in sectors 1 and 2, OC and OB, respectively. Note that any distribution inside the diversification cone X_1OX_2 is a possible equilibrium if both labor and capital are mobile internationally. If labor is not internationally mobile (which we assume throughout the paper), all points on line TT^* are equilibria. For example, point E', is one of the feasible equilibria, where home lends EE' amount of capital to foreign, and correspondingly, produces more labor intensive good 1 but less capital intensive good 2 (OC' and OB'), respectively. Before we discuss ways to address multiple equilibria in the next section, let us switch to sector-specific shocks.

3.4 Sector-Specific Shocks

We now consider sector specific shocks and demonstrate that such shocks may explain the *sign puzzle of current account*: that a labor abundant economy like China could export capital for a long period (i.e., run a persistent current account surplus), and a capital abundant economy like the United States could import capital for a long period (i.e., run a persistent current account deficit). We will start with the case of a sector-specific technology shock and then show how a trade liberalization such as China's accession to the World Trade Organization at the end of 2001 is equivalent to such a shock that could deliver a persistent current account surplus for China. To state the result differently, we provide an explanation for the Lucas Paradox (that capital travels upstream from a poor to a rich country) without resorting to the usual route of assuming different institutional quality and expropriation risks for the two types of economies.

3.4.1 Sector-Specific Technology Shocks

At the beginning of period t, let the home country be in steady state equilibrium in which $A_{1t} = A_{2t} = A^*$ where A^* is the world labor productivity. A labor intensive sector-specific shock in period $t+1$ is defined as $A_{1,t+1} > A^*$ but $A_{2,t+1} = A^*$, while a capital intensive sector-specific shock is defined as $A_{2,t+1} > A^*$ but $A_{1,t+1} = A^*$. It is important to note that factor price equalization no longer holds. Rewriting zero profit conditions (6) as

$$p_{1,t+1} = \phi_1(\frac{w_{t+1}}{A_{1,t+1}}, r_{t+1}) \text{ and } p_{2,t+1} = \phi_2(\frac{w_{t+1}}{A_{2,t+1}}, r_{t+1}) \tag{25}$$

and differentiating, we can show that $\frac{\partial w_{t+1}}{\partial A_{1,t+1}} > 0$, $\frac{\partial r_{t+1}}{\partial A_{1,t+1}} < 0$, $\frac{\partial w_{t+1}}{\partial A_{2,t+1}} < 0$, and $\frac{\partial r_{t+1}}{\partial A_{2,t+1}} > 0$. These results are in the spirit of Stopler-Samuelson theorem: A technological improvement in the labor intensive sector raises the wage rate but reduces the interest rate, while the technological improvement in the capital intensive sector does the reverse.

While a formal proof can be easily seen using equations (36) and (37) in section 4, we can explain the intuition here. As $A_{1,t+1}$ increases, the country produces more labor intensive good so that the labor demand increases. That raises the wage rate w_{t+1}. Since domestic goods prices are always equal to foreign goods prices even after the technology shock (in particular, $p_{2,t+1} = p^*_{2,t+1}$), to maintain the zero profit condition in sector 2, $p_{2,t+1} = \phi_2(\frac{w_{t+1}}{A_{2,t+1}}, r_{t+1})$, r_{t+1} must decline. Thus, we have $r_{t+1} < r^*_{t+1}$ as long as the home country remains diversified. So capital flows out as long as the capital-labor ratio at home is within the diversification cone. In Figure 2, the capital-labor ratio is represented by point E. As capital flows out, E moves down. Once E is below T, the country is specialized in producing good 1, and capital continues to flow out until the marginal product of capital in sector 1 is equal to the world interest rate r^*_{t+1}. The capital usage in the country, K_{t+1}, is now determined by the first order condition in sector 1:

$$\frac{p_{1,t+1}\partial f_1(A_{1,t+1}L, K_{t+1})}{\partial K_{t+1}} = r^*_{t+1} \tag{26}$$

and the amount of capital outflow, $-K^{inflow}_{t+1} = S_t(w_t, r^*_{t+1}, \beta, L) - K_{t+1}$.

On the other hand, if technology shock hits the capital intensive sector, we must have $r_{t+1} > r^*_{t+1}$ after the shock as long as the home country remains diversified. Similar to the above analysis, now the home country must import capital and become specialized in producing good 2. K_{t+1} is determined by

$$\frac{p_{2,t+1}\partial f_2(A_{2,t+1}L, K_{t+1})}{\partial K_{t+1}} = r^*_{t+1} \tag{27}$$

and the amount of capital inflow, $K^{inflow}_{t+1} = K_{t+1} - S_t(w_t, r^*_{t+1}, \beta, L)$.

To summarize, the key insight is that a technological improvement in a sector strengthens a country's comparative advantage in that sector, which raises the exports of that good, and the imports of the other good simultaneously. This process raises the demand for the factor used intensively in the sector that has experienced the technology shock, while reducing the demand for the other factor. Thus a technological improvement in the labor intensive sector (sector 1) increases the labor demand but reduces the investment demand, and therefore results in a capital outflow (current account surplus), while a technological improvement in the capital intensive sector does the opposite.

It is interesting to emphasize that goods trade and capital flows reinforce each other. For example, a technological improvement in the labor intensive sector initially increases the country's exports of the labor intensive good, which leads to a first round of capital outflow. The initial capital outflow, on the other hand, makes the country even more labor abundant, and therefore induces it to produce and export even more labor intensive good. This causes a second round of reduction in the investment demand and results in further capital outflow. This process continues until the country is completely specialized in producing labor intensive good. Thus, a productivity improvement in the labor intensive sector could result in a large amount of current account surplus.

3.4.2 Tariff Reductions

We now extend the above analysis to the case of tariff reductions. Let τ_i be the tariff rate in good i so that $p_{i,t+1} = (1+\tau_i)\, p^*_{i,t+1}$. First consider the case that the home country has comparative advantage in labor intensive good; that is, $\frac{A_1}{A_2} > \frac{A_1^*}{A_2^*}$. So the home country exports good 1 and imports good 2, and we assume $\tau_1 = 0$ and $\tau_2 > 0$. To simplify the analysis, we assume that the domestic interest rate before the shock is equal to the world interest rate, r^*.[6]

A cut in τ_2 implies a reduction in $p_{2,t+1}$. Using the Stopler-Samuelson theorem, we have $\frac{\partial w_{t+1}}{\partial p_{2,t+1}} < 0$, and $\frac{\partial r_{t+1}}{\partial p_{2,t+1}} > 0$. This can also be easily seen from equations

[6] As p_2 is higher than p_2^*, but $\frac{A_2}{A_1}$ is lower than $\frac{A_2^*}{A_1^*}$, Using (36), the domestic interest rate could be kept to equal the world interest rate before the tariff reduction.

(36) and (37). Thus the domestic interest rate after the tariff cut declines, so that $r_{t+1} < r^*_{t+1}$ as long as the country produces two intermediate goods. A similar logic in the case of a technology shock in the labor intensive sector also applies here: capital keeps flowing out until the country is specialized in producing labor intensive good.

Now consider the case in which the home country has the comparative advantage in capital intensive good and imports good 1. The tariff cut implies a reduction in $p_{1,t+1}$, and we have $\frac{\partial w_{t+1}}{\partial p_{1,t+1}} > 0$, and $\frac{\partial r_{t+1}}{\partial p_{1,t+1}} < 0$. Thus the domestic interest rate after the tariff cut rises, so that $r_{t+1} > r^*_{t+1}$ as long as the country remains diversified. This generates a capital inflow (current account deficit) until the country is specialized in producing capital intensive good.

Based on these discussions, we have the following proposition:

Proposition 2 *For a small open economy whose comparative advantage is in the labor intensive sector, a technological improvement in the labor intensive sector (or a tariff cut in the capital intensive sector) would generate a current account surplus, and induce the country to specialize in producing the labor intensive good. On the other hand, for a small open economy whose comparative advantage is in the capital intensive sector, a technological improvement in the capital intensive sector (or a tariff cut in the labor intensive sector) would generate a current account deficit, and induce the country to specialize in producing the capital intensive good.*

4 A Model with Labor Market Rigidity

Technically, constant returns to scale in the production function implies that factor prices are determined by product prices within the diversification cone. That causes problems of multiple equilibria in the case of endowment shocks. To obtain a unique equilibrium, some form of decreasing returns to scale needs to be introduced at a country level so that the factor prices can be affected by a change in the factor endowment. One possible strategy is to allow for convex costs to goods trade and capital flows. We consider instead frictions in the domestic labor market (in the form of an adjustment cost when labor switches sectors). This allow us to explicitly consider the role of domestic labor market institutions in current account adjustment process, and as a by-product, also eliminates multiple equilibria in the case of an endowment shock.

We choose to focus on frictions in labor market for the following reasons: First, collective bargaining and laws that make it difficult for firms to fire workers could impede labor mobility across sectors. Second, both labor and capital may be specific in the very short run and become flexible over time. In our context, frictions in the capital market impede both the access to the international capital market (which reduces the reliance on current account adjustment) and the reallocation of capital between tradable sectors within the economy (which increases the reliance on current account adjustment). These two opposing effects make the linkage between the capital market imperfections and patterns of current account adjustment less than a clear cut. We therefore find it useful to focus on labor market rigidities.

The timing of the model is as follows. The economy is in a steady state in period t. At the beginning of period $t+1$, young individuals are already deployed in the two sectors. L_{it+1} is hired in sector i at time $t+1$. Then either endowment shocks or sector-specific shocks hit the economy in period $t+1$.

4.1 Endowment Shocks and Current Account Adjustment

4.1.1 Economy-Wide Technology Shocks

We consider an economy-wide technology shock that increases $A_{t+1} = A_{1,t+1} = A_{2,t+1}$ to $A'_{t+1} = A_{t+1} + \Delta A_{t+1}$. When labor is perfectly mobile across sectors, our model would coincide with the HO setup, and the domestic interest rate remains at r^*_{t+1} after shock. If labor is assumed to be fixed to the sectors, on the other hand, this becomes a specific-labor model. Since no labor moves from capital-intensive sector 2 to labor-intensive sector 1, less labor intensive good would be produced than that in the HO setup. Both the labor demand and the wage rates would be lower. As product prices are fixed in a small country, the interest rate must be higher. That is, $r^s_{t+1} > r^*_{t+1}$.[7] Moreover, the wage rate in the labor intensive sector 1, $w^s_{1,t+1}$, would be higher than that in the capital intensive sector 2, $w^s_{2,t+1}$, and output in both sectors would increase. In classic trade theories, the specific-factor model is viewed as a short-run equilibrium, and the flexible-labor-market HO model represents the long run equilibrium. In the transition from the short run to the long run, labor (and capital) move from the capital-intensive sector to the labor-intensive sector. Once reaching the long run equilibrium, factor prices go back to (q^*_{t+1}, r^*_{t+1}), and the output of the labor intensive good increases, but the output of the capital intensive good decreases, in accordance with the Rybczynski theorem.

Between these two polar cases, there are various levels of partial labor market rigidity. To parameterize the degree of labor market rigidity, we assume that when a unit of labor moves from one sector to another, it would earn only λ fraction of the prevailing wage in the new sector. A higher λ represents a more flexible labor market. At the one extreme, $\lambda = 1$ represents the HO model (in which labor market is completely flexible); at the other extreme, $\lambda = 0$ represents the specific-labor model (in which there is no labor mobility). The post-shock wage ratio in the specific-labor model, $\frac{w^s_{2,t+1}}{w^s_{1,t+1}}$, defines the upper bound for the wage differential. Therefore, for $\lambda \leq \frac{w^s_{2,t+1}}{w^s_{1,t+1}}$, an individual intending to move from the capital-intensive sector 2 to the labor-intensive sector 1 would see a decline in her wage income. As a result, no labor relocation takes place, and wage rates would stay at $(w^s_{1,t+1}, w^s_{2,t+1})$. So the entire range of $0 \leq \lambda \leq \frac{w^s_{2,t+1}}{w^s_{1,t+1}}$ effectively corresponds to the specific-labor model. If $\lambda > \frac{w^s_{2,t+1}}{w^s_{1,t+1}}$, labor in sector 2 would find it worthwhile to move to sector 1 until $w_{2,t+1} = \lambda w_{1,t+1}$. The relationship between the degree of labor market flexibility and the post-shock wage rates in two sectors can be summarized by the

[7] We use superscript "s" to denote variables in the specific-labor model.

following expression:

$$w_{2,t+1} = \{ \begin{array}{c} \lambda w_{1,t+1},\ \frac{w^s_{2,t+1}}{w^s_{1,t+1}} < \lambda \leq 1 \\ w^s_{2,t+1},\ 0 \leq \lambda \leq \frac{w^s_{2,t+1}}{w^s_{1,t+1}} \end{array}$$

Since, when $0 \leq \lambda \leq \frac{w^s_{2,t+1}}{w^s_{1,t+1}}$, a (moderate) change in the labor market flexibility has no effect on the economy, we will focus on scenarios in which $\frac{w^s_{2,t+1}}{w^s_{1,t+1}} < \lambda \leq 1$ thereafter.

We drop the subscript $t+1$ in the production function, $f_i(A_{t+1}L_{i,t+1}, K_{i,t+1})$, in the rest of this section for simplicity. With free goods trade but no capital flows, the equilibrium conditions are:

$$\begin{aligned} p_1 \frac{\partial f_1(A'_1 L_1, K_1)}{\partial K_1} &= p_2 \frac{\partial f_2(A'_2 L_2, K_2)}{\partial K_2} = r & (28) \\ \lambda p_1 \frac{\partial f_1(A'_1 L_1, K_1)}{\partial L_1} &= p_2 \frac{\partial f_2(A'_2 L_2, K_2)}{\partial L_2} & (29) \\ K_1 + K_2 &= s(w_t, r, \beta)L \text{ and} & (30) \\ L_1 + L_2 &= L & (31) \end{aligned}$$

Equation (28) states that the marginal products of capital in the two sectors are equal to the interest rate, while equation (29) is the condition that $w_2 = \lambda w_1$. Equations (30) and (31) are capital and labor full employment conditions. Four endogenous variables, L_1, L_2, K_1, and K_2 are determined by four equations in (28), (29), (30), and (31), and then $r = p_i \frac{\partial f_i(A'_i L_i, K_i)}{\partial K_i}$ and $w_1 = p_1 \frac{\partial f_1(A'_1 L_1, K_1)}{\partial L_1}$.

As discussed by Neary (1978), physical and value factor intensities, $\frac{K_i}{L_i}$ and $\frac{rK_i}{w_i L_i}$, may differ when $w_1 \neq w_2$, which could generate paradoxical results in comparative statics. To simplify the analysis and avoid these paradoxes, we assume a Cobb-Douglas production function. Let

$$f_1(A_1 L_1, K_1) = (A_1 L_1)^{\alpha_1} K_1^{1-\alpha_1} \text{ and } f_2(A_2 L_2, K_2) = (A_2 L_2)^{\alpha_2} K_2^{1-\alpha_2} \qquad (32)$$

where $\alpha_1 > \alpha_2$. Therefore, sector 1 is more labor intensive than sector 2 in both physical and value senses. Rewriting equations (28) and (29), we have:

$$p_1 (1-\alpha_1) A_1^{\alpha_1} \left(\frac{K_1}{L_1}\right)^{-\alpha_1} = p_2 (1-\alpha_2) A_2^{\alpha_2} \left(\frac{K_2}{L_2}\right)^{-\alpha_2} = r \tag{33}$$

$$\lambda p_1 \alpha_1 A_1^{\alpha_1} \left(\frac{K_1}{L_1}\right)^{1-\alpha_1} = p_2 \alpha_2 A_2^{\alpha_2} \left(\frac{K_2}{L_2}\right)^{1-\alpha_2} = \lambda w_1 \tag{34}$$

As a comparison, note that the wage rates in both sectors are equal *before the shock*. Thus, *before the shock,* equation (34) is replaced by

$$p_1 \alpha_1 A_1^{\alpha_1} \left(\frac{K_1}{L_1}\right)^{1-\alpha_1} = p_2 \alpha_2 A_2^{\alpha_2} \left(\frac{K_2}{L_2}\right)^{1-\alpha_2} \tag{35}$$

From equations (33), (34), and (35), we obtain the solution to the factor prices *before the shock* ($A_1 = A_2 = A^*$) as

$$r^0 = \Phi_1 p_1^{-\frac{\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1}{\alpha_1-\alpha_2}} \left(\frac{A_2}{A_1}\right)^{\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}} = r^* \tag{36}$$

$$w^0 = \Phi_2 p_1^{\frac{1-\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1-1}{\alpha_1-\alpha_2}} (A_1)^{\frac{\alpha_1(1-\alpha_2)}{\alpha_1-\alpha_2}} (A_2)^{-\frac{\alpha_2(1-\alpha_1)}{\alpha_1-\alpha_2}} = w^* \tag{37}$$

and the factor prices *after the shock* as

$$\overline{r}(p_1, p_2, A_1', A_2', \lambda) = \Phi_1 p_1^{-\frac{\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1}{\alpha_1-\alpha_2}} \left(\frac{A_2'}{A_1'}\right)^{\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}} \lambda^{-\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}} \tag{38}$$

$$\overline{w}_1(p_1, p_2, A_1', A_2', \lambda) = \Phi_2 p_1^{\frac{1-\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1-1}{\alpha_1-\alpha_2}} (A_1')^{\frac{\alpha_1(1-\alpha_2)}{\alpha_1-\alpha_2}} (A_2')^{-\frac{\alpha_2(1-\alpha_1)}{\alpha_1-\alpha_2}} \lambda^{\frac{(1-\alpha_1)\alpha_2}{\alpha_1-\alpha_2}} \tag{39}$$

where Φ_1 and Φ_2 are some constants. We use an upper bar to denote the solution to the economy under free goods trade but financial autarky. In the case of an aggregate technology shock such that $A_1' = A_2' = A'$, equations (38) and (39) reveal that $\overline{r} \geq r^*$. A set of comparative statics, to be used later for our results, are summarized in Lemmas 1 and 2. A formal proof is relegated to Appendix 6.1.

Lemma 1 *Let sector 1 be labor intensive. With free goods trade but financial autarky, different levels of labor market flexibility imply different allocations of labor and capital in the two sectors after a shock. The relationship can be summarized as follows:* $\frac{\partial \overline{L}_1}{\partial \lambda} > 0$, $\frac{\partial \overline{K}_1}{\partial \lambda} > 0$, $\frac{\partial \overline{L}_2}{\partial \lambda} < 0$, $\frac{\partial \overline{K}_2}{\partial \lambda} < 0$ *and* $\frac{\partial \overline{r}}{\partial \lambda} < 0$.

When the labor market is partially rigid, the movement of labor and capital from sector 2 to sector 1 in response to a shock is incomplete. The more flexible is the labor market, the larger is the adjustment of factors from sector 2 to 1, and the closer the post-shock interest rate is to the world interest rate r^*. Without labor market rigidities, the wage rates in the two sectors must be equal. In that case, the interest rate and the wage always move in the opposite direction in response to a shock. With labor rigidities, the wage rates in the two sectors are not the same after a shock. It is useful to know the post-shock relationship between the ratio of the two wages and the interest rate, which is given by the following lemma.

Lemma 2 *Whenever the interest rate increases, the ratio of the wage rates in sector 1 to sector 2,* w_1/w_2*, must also increase.*

We are now ready to consider capital flows. After a shock, labor moves from sector 2 to sector 1, and some foreign capital is also attracted into the country as $r^s > r^*$. Both the labor reallocation and the capital inflow reduce the wage gap between the two sectors. At some point, the equality $\overline{w}_2 = \lambda \overline{w}_1$ is reached. However, if domestic interest is still higher than the world level, foreign capital continues to flows in, until the domestic interest rate reaches the level of the world interest rate r^*. Using Lemma 2, $\lambda w_1/w_2 < 1$ as the interest rate decreases. This implies that the cost of labor movement, $(1-\lambda)\, w_1$, exceeds the benefit, $w_1 - w_2$. Therefore, labor stops to move and the labor usage is effectively fixed in each sector before the home interest rate reaches the world level. To simplify the discussion and without loss of generality, we assume that foreign capital starts to flow into the country after labor has adjusted to the point that the equality $\overline{w}_2 = \lambda \overline{w}_1$ has been reached.

A graphical illustration in Figure 3 may provide further intuition. While the length of the horizontal axis is equal to the total supply of capital, the vertical axis measures the interest rate. The value marginal product of capital curves for sectors 1 and 2, labeled as V_1 and V_2, respectively, are plotted relative to origins O_1 and O_2. The equilibrium position without capital flows is shown by E where $V_1 = p_1 \partial f_1(\overline{L}_1(\lambda), K_1)/\partial K_1$ and $V_2 = p_2 \partial f_2(\overline{L}_2(\lambda), S - K_1)/\partial K_2$ intersect. The domestic capital supply, $S = s(w_t, r^*, \beta)L$, since domestic consumers expect that the world interest rate, r^*, will be the equilibrium interest rate when capital is mobile both internationally and between the sectors. With goods trade but no capital flows, the domestic interest rate would have been $\overline{r}(\lambda) > r^*$. As capital flows from the foreign to home country, both the right origin, O_2, and the value marginal product of capital curves for sector 2, V_2, shift to the right. In equilibrium the capital employed by home country is increased to $K = S + K^{inflow}$ where K^{inflow} is the amount of capital inflow. V_2 shifts to $V_2'' = p_2 \partial f_2(L_2(\lambda), K - K_1)/\partial K_2$ which intersects V_1 at E''; the interest rate is equal to r^* after the capital inflow.

As capital flows into the country, the condition (34) no longer holds since $w_2 > \lambda w_1$. Labor usages in both sectors, $\overline{L}_1$ and $\overline{L}_2$ are fixed. We denote the labor usage in sector i as $\overline{L}_i(\lambda)$ since it is a function of λ. The equation (33) becomes

$$p_1 (1 - \alpha_1) A_1^{\alpha_1} \left(\frac{K_1}{\overline{L}_1(\lambda)} \right)^{-\alpha_1} = p_2 (1 - \alpha_2) A_2^{\alpha_2} \left(\frac{K - K_1}{\overline{L}_2(\lambda)} \right)^{-\alpha_2} \tag{40}$$

In equilibrium we must have $r = r^*$. The domestic savings in equilibrium, $s(w_t, r^*, \beta)L$, does not vary as λ changes. Thus, we have

$$K = s(w_t, r^*, \beta)L + K^{inflow} \tag{41}$$

$$r^* = p_1 (1-\alpha_1) A_1^{\alpha_1} \left(\frac{K_1}{\overline{L}_1(\lambda)} \right)^{-\alpha_1} \tag{42}$$

$\overline{L}_i(\lambda)$ are determined by conditions (28), (29), (30), and (31). Then K_i and the amount of capital inflow, K^{inflow}, are solved by equations (40), (41) and (42).[8] The interest rate before capital flow, $\overline{r}(\lambda)$, is lower as λ becomes larger. Thus, it is easy to see in Figure 3 that K^{inflow} will be smaller as the labor market becomes more flexible.

The formal proof is straightforward. Substituting (41) into (40) and differentiating equations (40) and (42) with respect to λ, we obtain

$$\frac{\partial K^{inflow}}{\partial \lambda} = \left(\frac{K_1}{L_1} - \frac{K_2}{L_2} \right) \frac{\partial \overline{L}_1}{\partial \lambda} \tag{43}$$

$\frac{K_1}{L_1} < \frac{K_2}{L_2}$ since sector 1 is labor intensive and $\frac{\partial \overline{L}_1}{\partial \lambda} > 0$ due to Lemma 1. Equation (43) therefore proves that $\frac{\partial K^{inflow}}{\partial \lambda} < 0$. We summarize our results by the following proposition.

Proposition 3 *Consider a small-open economy with labor market flexibility indexed by λ. An increase in A_{t+1} generates a current account deficit (capital inflows). The more flexible the labor market (i.e., the bigger the value of λ), the smaller the size of the current account response.*

4.1.2 Capital Supply Shocks

Natural disasters, international aids, and changes in discount rate in period $t+1$ can all change domestic capital supply. Assume that one of these shocks reduces the

[8] $\overline{K}_i(\lambda)$ solved in (28), (29), (30), and (31) is the capital usage without international capital flows. Since capital is mobile across sectors, the capital usage in sector i will change when foreign capital flows into the country.

domestic capital supply. When labor is perfectly mobile across sectors, domestic factor prices (q_i^*, r_i^*) will be determined by (21) both before and after the shock. If labor allocation is fixed to the two sectors, on the other hand, a decrease in capital supply, in the absence of cross border capital flows, would increase the domestic interest rate, but reduce wage rate in both sectors. Moreover, the wage rate in the capital intensive sector, w_2^s, will be lower than the wage rate in the labor intensive sector, w_1^s.

For intermediate levels of labor market flexibility, $\frac{w_2^s}{w_1^s} < \lambda < 1$, our analysis here is essentially the same as the case of an economy-wide labor productivity shock. The domestic interest rate under financial autarky $\overline{r}(\lambda)$ is determined by equation (38) and decreases as λ becomes larger. When capital market opens. Therefore, the country runs a current account deficit if the labor market is rigid, but the current account deficit vanishes as the labor market becomes more flexible. We summarize our results by the following proposition.

Proposition 4 *Consider a small-open economy with labor market flexibility indexed by λ. A shock that effectively decreases the capital supply generates a current account deficit (i.e., capital inflows). The more flexible the labor market (i.e., the bigger is λ), the smaller the current account response.*

As the labor market approaches perfect flexibility ($\lambda \to 1$), the current account response to a shock approaches zero. Domestic factor prices would converge to (q^*, r^*). In other words, while the wage rate changes from q^*A to q^*A', the interest rate remains at r^* after the shock. No capital flow occurs since the interest rate doesn't change. Therefore, all adjustment goes through the channel of a change in the composition of goods trade. If the labor market is sufficiently flexible, the size of current account adjustment would be small in case of an endowment shock. Thus, our model can potentially explain the *level puzzle*.

4.2 Some Comments on Sector-Specific and Common Shocks

Without labor market rigidity, we have shown that a sector-specific shock to labor intensive sector could cause a labor abundant country to run a current account surplus. This result does not change qualitatively with the introduction of labor market rigidities, though the magnitude of the current account is modified. We summarize the result in the following proposition and demonstrate in detail in Appendix 6.2.

Proposition 5 *With a sufficiently flexible labor market, a technological improvement in the labor intensive sector (or a tariff cut on the capital intensive good) in period* $t+1$ *induces the country to run a current account surplus and specialize in producing the labor intensive good. On the other hand, a technological improvement in the capital intensive sector (or a tariff cut on the labor intensive sector) in period* $t+1$ *does the exact opposite.*

A noteworthy implication of our model with labor market rigidity is that a globally common shock - one that hits all countries at the same time - may generate different current account responses across countries, in contrast to a standard result in the literature (see Glick and Rogoff, 1995) that a common shock does not generate a significant effect on current account. To see this, we examine expressions (38). It is immediately clear that the interest rates in two small countries differ in financial autarky if their degree of labor market rigidity is different. In the case of economy-wide technology shock or a technology shock specific to the labor intensive sector, the country with a more rigid labor market imports capital (or to run a current account deficit). For a productivity shock specific to the capital intensive sector, the opposite is true: the country with a more rigid labor market exports capital (or to run a current account surplus).

So far all of our results are derived under the assumption that any productivity change takes the form of augmenting labor. Alternatively, if we assume a Hicks-neutral technical change, all of the qualitative results will remain, except that the economy-wide technology shock can no longer be grouped with other endowment shocks. A positive (Hicks-neutral) economy-wide technology shock increases both the wage rate and the interest rate proportionally, so that capital tends to flow into the country after the shock. If the labor market is perfectly flexible, capital would flow in until the country specializes in producing good 2. Thus a Hicks-neutral aggregate technology shock works just like a sector-specific technology shock to the capital intensive sector in our model.

5 Conclusion

This paper proposes a theory of current account adjustment with multiple tradable sectors and rigidities in the labor market. We import insights from the classic theories of international trade, particularly the Heckscher-Ohlin model and the specific factor model, into the discussion of savings, investment and current account. A central theme is that a change in the composition of output and goods trade is another channel for an economy to adjust to a shock that would substitute for or complement the channel of current account adjustment. Domestic labor market rigidities affect the relative reliance of the two adjustment channels.

The model provides a potential solution to the "*level puzzle*": When a shock is such that the two channels are substitutes, a change in the composition of the two sectors could make a current account response unnecessary. The model also suggests a way to address the "*sign puzzle*" (without resorting to differential qualities of financial systems). In particular, trade liberalizations can produce the result that a poor country would export capital and a rich country would import capital. That is because trade liberalization for a developing country (which has a low K/L ratio) typically means a cut in the tariff on capital-intensive goods. In contrast, trade liberalization for a rich country (with a high K/L ratio) typically means a cut in tariff on labor-intensive goods. Therefore, the pattern of capital flowing from a poor to a rich country - something known as the Lucas paradox - can be a natural outcome of trade liberalizations, even in a model without cross country differences in property rights institutions or financial development.

While our model focuses on delivering qualitative results in a simple and transparent way that permits closed form solutions, a useful direction of future research is to study the quantitative implications of the model and check how well they match the data.

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6 Appendix

6.1 Proof of Lemmas 1 and 2

Solving equations (33) and (34) for $\frac{K_i}{L_i}$, we have:

$$\frac{K_1}{L_1} = \Gamma_1(p_1, p_2, A_1, A_2)\lambda^{\frac{\alpha_2}{\alpha_1-\alpha_2}} \tag{44}$$

$$\frac{K_2}{L_2} = \Gamma_2(p_1, p_2, A_1, A_2)\lambda^{\frac{\alpha_1}{\alpha_1-\alpha_2}} \tag{45}$$

where $\Gamma_1(.)$ and $\Gamma_2(.)$ are functions of p_1, p_2, A_1 and A_2. Differentiating equations (44), (45), (30), (31), and substituting (38) into (30), we obtain:

$$\frac{dK_1}{K_1} - \frac{dL_1}{L_1} = \frac{\alpha_2}{\alpha_1-\alpha_2}\frac{d\lambda}{\lambda} \tag{46}$$

$$\frac{dK_2}{K_2} - \frac{dL_2}{L_2} = \frac{\alpha_1}{\alpha_1-\alpha_2}\frac{d\lambda}{\lambda} \tag{47}$$

$$dK_1 + dK_2 = \frac{Lr\partial s(.)}{\partial r}\left(-\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}\right)\frac{d\lambda}{\lambda} \tag{48}$$

$$dL_1 + dL_2 = 0 \tag{49}$$

Solving (46), (47), (48), and (49), we obtain

$$\begin{aligned}\left(\frac{K_2/L_2}{K_1/L_1}-1\right)\frac{dL_1}{L_1} &= \left(\frac{\alpha_2}{\alpha_1-\alpha_2}+\frac{K_2\alpha_1}{K_1\left(\alpha_1-\alpha_2\right)}+\frac{\frac{\partial s(.)}{\partial r}Lr\alpha_1\alpha_2}{\left(\alpha_1-\alpha_2\right)K_1}\right)\frac{d\lambda}{\lambda} \quad (50)\\ \left(1-\frac{K_1/L_1}{K_2/L_2}\right)\frac{dK_1}{K_1} &= \left(\frac{\alpha_2}{\alpha_1-\alpha_2}+\frac{L_2\alpha_1}{L_1\left(\alpha_1-\alpha_2\right)}+\frac{\frac{\partial s(.)}{\partial r}LL_2r\alpha_1\alpha_2}{\left(\alpha_1-\alpha_2\right)L_1K_2}\right)\frac{d\lambda}{\lambda} \quad (51)\end{aligned}$$

$\frac{K_2/L_2}{K_1/L_1}>1$ since the sector 2 is capital intensive. Thus (50) and (51) proves that $\frac{dL_1}{d\lambda}>0$ and $\frac{dK_1}{d\lambda}>0$. Using (48) and (49), we immediately have $\frac{dL_2}{d\lambda}<0$ and $\frac{dK_2}{d\lambda}<0$, while $\frac{dr}{d\lambda}<0$ can be easily seen from (38). That proves Lemma 1.

We now prove Lemma 2. Zero profit conditions in specific-labor model implies

$$\begin{aligned}p_1 &= \alpha_1^{-\alpha_1}\left(1-\alpha_1\right)^{\alpha_1-1}\left(w_1/A_1\right)^{\alpha_1}r^{1-\alpha_1}\\ p_2 &= \alpha_2^{-\alpha_2}\left(1-\alpha_2\right)^{\alpha_2-1}\left(w_2/A_2\right)^{\alpha_2}r^{1-\alpha_2}\end{aligned}$$

Differentiating, we obtain:

$$\frac{d\left(w_1/w_2\right)}{w_1/w_2}=\left(\frac{\alpha_1-\alpha_2}{\alpha_1\alpha_2}\right)\frac{dr}{r}$$

So w_1/w_2 increases as r increases.

6.2 Sector-Specific Shocks with Labor Market Rigidities

We first discuss a technology shock specific to the labor intensive sector that increases A_1 to A_1' while keeping A_2 unchanged in period $t+1$. As we discussed in section 3, the labor productivity improvement in sector 1 increases the exports (imports) of good 1 (good 2), and therefore raises the labor demand, while reducing the investment demand. Thus, wage rate would increase, but the interest rate would decline. If $\lambda=1$ (perfectly flexible labor market), with trade openness but financial autarky, expression (38) shows that the domestic interest rate declines as A_1 increases. On the other hand, if labor is sector-specific, we can show that the shock raises the interest rate, using Figures 1 and 3.

For a given level of capital stock, represented by the length of O_1O_2 in Figure 3, as A_1 increases, the value marginal product of capital curves in sectors 1, V_1V_1, shifts out to $V_1'V_1'$, while V_2V_2 doesn't change. Thus, the interest rate increases from r to r'. As for any given level of K the interest rate increases, therefore the investment demand curve in Figure 1, II, shifts out, while the saving curve, SS, is not affected. As a result, the domestic equilibrium interest rate increases. Because labor can not move from sector 2 to sector 1, the wage rate in labor intensive sector 1, w_1^s, is higher than, w_2^s.

For an intermediate level of labor market flexibility, $\frac{w_2^s}{w_1^s}<\lambda<1$, expression (38) shows that the interest rate declines if λ becomes larger. There exists a threshold for the labor market flexibility, $\overline{\lambda}_1$; below which, the domestic interest rate under financial autarky is higher than the world interest rate, r^*, and above which it is lower than r^*.

Foreign capital flows into the country when $\frac{w_2^s}{w_1^s} \leq \lambda < \overline{\lambda}_1$. Similar to the analysis in the last subsection, as foreign capital flows in, the interest rate decreases, while the wage rate differential $w_1 - w_2$ further shrinks so that the labor usage is effectively fixed in each sector. In equilibrium we must have $r = r^*$, and the amount of capital inflow, K^{inflow}, decreases as λ increases.

When $\overline{\lambda}_1 \leq \lambda < 1$, the situation is different. Because now the domestic interest rate is lower than r^*, domestic capital flows out and the country runs a current account surplus. As capital flows out, the interest rate would increase if labor were fixed in both sectors. However, using Lemma 2, wage rate differential $w_1 - w_2$ would have increased, had the interest rate increased. Thus, labor will move from sector 2 to sector 1, and in equilibrium the equality $w_2 = \lambda w_1$ must hold. That is, both equations (33) and (34) still hold as long as both products are produced. Therefore, the interest rate, $r(\lambda)$, and the wage rate in sector 1, $w_1(\lambda)$, are determined by equations (38) and (39). It is immediately seen that as long as the country produces two products, the domestic interest rate, $r(\lambda)$, is less than r^*, and capital will keep flowing out, until the country is specialized in producing the labor intensive good 1. The capital usage in the country, K, is then determined by equation (26), and the amount of current account surplus equals $-K_{t+1}^{inflow} = S_t(w_t, r_{t+1}^*, \beta, L) - K_{t+1}$.

If the labor market is sufficiently flexible, a positive technology shock in labor intensive sector may trigger a large current account surplus. How could that happen? Again, the key mechanism is the interaction between goods trade and capital flows. The marginal costs of production in home and foreign countries are:

$$\begin{aligned} c_1 &= \Phi_1 w_1^{\alpha_1} \left(A_1'\right)^{-\alpha_1} r^{1-\alpha_1},\ c_2 = \Phi_1 \left(\lambda w_1\right)^{\alpha_2} \left(A_2\right)^{-\alpha_2} r^{1-\alpha_2} \text{ and} \\ c_1^* &= \Phi_1 w^{*\alpha_1} \left(A_1\right)^{-\alpha_1} r^{*1-\alpha_1},\ c_2^* = \Phi_1^{\alpha_2} w_2^{*\alpha_2} \left(A_2\right)^{-\alpha_2} r^{*1-\alpha_2} \end{aligned}$$

where Φ_i is some constant. Before shock we had $\lambda = 1$, $w_1 = w^*$ and $r = r^*$. As A_1 increases to A_1', it is easy to see that $c_1/c_2 < c_1^*/c_2^*$ right after the shock. Thus, the country has the comparative advantage in producing labor intensive good, and therefore exports good 1. This intra-temproal trade changes the industrial composition and results in higher demand for labor and less demand for investment at home than abroad, so that $w_1 > w^*$ and $r < r^*$ after the shock. Domestic capital flows out; that makes the country even more labor abundant, and strengthens the comparative advantage in producing good 1. As long as the labor market is sufficiently flexible (λ is large), the inequality $c_1/c_2 < c_1^*/c_2^*$ holds as labor keeps moving from sector 2 to sector 1, and capital keeps flowing out. Eventually, the country specializes in producing good 1. It is interesting to note that the labor market flexibility, λ, plays a key role in determining the sign of capital flow. If the labor market were very rigid ($\lambda < \overline{\lambda}_1$), we would observe the current account deficit, rather than the surplus.

Next we consider a sector-specific shock in the capital-intensive sector, which increases A_2 to A_2' while keeping A_1 unchanged. The country now has comparative advantage in producing good 2 and therefore exports it. Factors would flow from sector 1 to sector 2. If labor is fixed in each sector, the wage rate in sector 2, w_2^s, is higher than that in sector 1, w_1^s. All previous analysis in section 4 still goes through, if we replace λ by $\frac{1}{\lambda}$. The equations (38) and (39) now become

$$\overline{r}(.) = \Phi_1 p_1^{-\frac{\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1}{\alpha_1-\alpha_2}} \left(\frac{A_2'}{A_1'}\right)^{\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}} \lambda^{\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}} \quad (52)$$

$$\overline{w}_1(.) = \Phi_2 p_1^{\frac{1-\alpha_2}{\alpha_1-\alpha_2}} p_2^{\frac{\alpha_1-1}{\alpha_1-\alpha_2}} \left(A_1'\right)^{\frac{\alpha_1(1-\alpha_2)}{\alpha_1-\alpha_2}} \left(A_2'\right)^{-\frac{\alpha_2(1-\alpha_1)}{\alpha_1-\alpha_2}} \lambda^{-\frac{(1-\alpha_1)\alpha_2}{\alpha_1-\alpha_2}} \quad (53)$$

and $\overline{w}_1 = \lambda \overline{w}_2$.

When $\lambda = 1$, with trade openness but financial autarky, expression (52) shows that the domestic interest rate after the shock is higher than the world interest rate r^*, as the intra-temporal trade increases the investment demand. When labor is fixed, similar to the case of the technology shock in labor intensive sector, the domestic interest rate after the shock is also higher than r^*, as the marginal product of capital in sector 2 is higher. For an intermediate level of labor market flexibility where $\frac{w_2^s}{w_1^s} < \lambda < 1$, expression (52) shows that the domestic interest rate under financial autarky increases as the labor market becomes more flexible.

Let $\frac{w_2^s}{w_1^s} < \lambda \leq 1$. When international capital market opens, capital flows into the country as $\overline{r}(\lambda) > r^*$. As capital flows in, the interest rate would decline, if labor were fixed in both sectors. As a result, the wage rate differential $w_2 - w_1$ would increase using Lemma 2. Thus, labor will move from sector 1 to sector 2, and the equality $\overline{w}_1 = \lambda \overline{w}_2$ will hold. Therefore, the interest rate, $r(\lambda)$, and the wage rate in sector 1, $w_1(\lambda)$, are determined by equations (52) and (53). Similar to the case of a specific-shock in the labor intensive sector, as long as the country produces two products, the domestic interest rate, $r(\lambda)$, would be higher than r^*, and capital will keep flowing into the country, until the country is specialized in producing the capital intensive good 2. The capital usage in the country, K, is then determined by equation (27), and the amount of current account deficit equals $-K^{inflow} = -\left[K - S_t(w_t, r_{t+1}^*, \beta, L)\right]$.

6.2.1 Tariff Reductions

The analysis above can be easily extended to the case of trade liberalization. Like section 3.4.2, if the country imports good 2, then a cut in τ_2 implies a reduction in p_2. Trade liberalization in this case means a reduction in p_2. The domestic interest rate, $\overline{r}(\lambda)$, and the wage rate in sector 1, $\overline{w}_1(\lambda)$, are determined by equations (38) and (39). The situation now is similar to the case of sector-specific technology shock in the labor intensive sector. If the labor market is sufficiently flexible, $\overline{r}(\lambda) < r^*$, and capital will keep flowing out, until the country is specialized in producing the labor intensive good 1.

If the country imports good 1, then a cut in τ_1 implies a reduction in p_1. The domestic interest rate, $\overline{r}(\lambda)$, and the wage rate in sector 1, $\overline{w}_1(\lambda)$, are determined by equations (52) and (53) as long as both products are produced. With the same analysis as in the case of sector-specific technology shock in the capital intensive sector, if the labor market is sufficiently flexible (λ is sufficiently close to 1), the domestic interest rate $\overline{r}(\lambda)$, is higher than r^*, and capital will keep flowing in, until the country is specialized in producing the capital intensive good 2. The above results are summarized in Proposition 5 in the text.

A recurrent theme in the discussion of all types of shocks is that the degree of labor market flexibility affects how the current account responds to a shock. However, it is interesting to note that labor market rigidities affect the cases of endowment shocks and sector-specific shocks in a different way. This difference is due to whether goods trade and capital flow are substitutes or complements. In the case of a endowment shock, goods trade and capital flows are substitutes. Labor market flexibility facilitate changes in the industrial composition in response to a shock, which implies a smaller current account response. For a sector-specific shock, on the other hand, goods trade and capital flow are complements.[9] Therefore, as increased labor market flexibility facilitates the adjustment in domestic industrial structure, the change in current account is magnified.

6.3 Current Account Adjustment in a Large Country

Using the aggregate technology shock as an example, we study the large country case in this subsection. As labor productivity improves from A to A', the relative supply of the labor intensive good to the capital intensive good, X_1/X_2, increases. As a result, the world relative price of good 1, p_1/p_2, declines. Therefore, in the foreign country, sector 2 expands relative to sector 1 and the wage rate in sector 2, w_2^*, is higher than that in sector 1, w_1^*. The counterparts of equilibrium conditions (28), (29), (30) and (31) in the foreign country without capital flows are:

$$p_1 \frac{\partial f_1(A^* L_1^*, K_1^*)}{\partial K_1^*} = p_2 \frac{\partial f_2(A^* L_2^*, K_2^*)}{\partial K_2^*} = r^* \quad (54)$$

$$p_1 \frac{\partial f_1(A^* L_1^*, K_1^*)}{\partial L_1^*} = \lambda^* p_2 \frac{\partial f_2(A^* L_2^*, K_2^*)}{\partial L_2^*} \quad (55)$$

$$L_1^* + L_2^* = L^*, \text{ and } K_1^* + K_2^* = s(w_t^*, r^*, \beta) L^* \quad (56)$$

Labor market rigidity in the foreign country, λ^*, differs from that at home. Moreover, cross-sector factor adjustments in the two countries go in opposite directions. Sector 1 expands at home due to the increase in effective labor endowment, but sector 2 expands in the foreign country due to an increase in the world market relative price of good 2. Equation (55) represents $w_1^* = \lambda^* w_2^*$ and is the reverse of the equation (29). The world market clearing conditions for the intermediate goods are:

$$X_1(p_1, p_2) + X_1^*(p_1, p_2) = f_1(A' L_1, K_1) + f_1(A^* L_1^*, K_1^*) \quad (57)$$

$$X_2(p_1, p_2) + X_2^*(p_1, p_2) = f_2(A' L_2, K_2) + f_2(A^* L_2^*, K_2^*) \quad (58)$$

[9] Readers are guided to Markusen (1983) and Markusen and Svensson (1985) for additional discussions on complementarity between goods trade and factor movements.

where $X_i(p_1, p_2)$ is the derived demand for intermediate good i in the home country, which is the inverse function of equation (10), and $X_i^*(p_1, p_2)$ is its counterpart in the foreign country.

First consider intra-temporal equilibrium without capital flows. Twelve endogenous variables, L_1, K_1, L_2, K_2, L_1^*, K_1^*, L_2^*, K_2^*, p_1, p_2, r, and r^* are determined by twelve equations (28), (29), (30), (31), (54), (55), (56), (57), and (58). By comparing the domestic interest rate r with the foreign interest rate r^*, we can determine the direction of capital flow.

Now let K^{inflow} be the amount of capital inflow (intertemporal trade) to the home country. The equilibrium of intra-temporal and intertemporal trade is then determined by the twelve equations described above, replacing domestic and foreign capital stocks, $s(w_t, r, \beta)L^*$ and $s(w_t^*, r^*, \beta)L^*$, by $s(w_t, r, \beta)L^* + K^{inflow}$ and $s(w_t^*, r^*, \beta)L^* - K^{inflow}$, respectively, and adding a world capital market clearing condition:

$$p_1 \frac{\partial f_1(A' L_1, K_1)}{\partial K_1} = p_1 \frac{\partial f_1(A^* L_1^*, K_1^*)}{\partial K_1^*} \tag{59}$$

A closed form solution is not possible without some further simplifying assumptions. The comparison between r and r^*, which depends on the levels of labor market rigidity both at home and abroad, is complicated, too. Fortunately, for one interesting special case we are able to determine the adjustment pattern to a shock. Specifically, if the domestic labor market is perfectly mobile ($\lambda = 1$), but the foreign labor market is rigid ($\lambda^* < 1$), we are able to compare the financial autarky levels of domestic and foreign interest rates and the qualitative results of Proposition 3 remains.

Using Stolper-Samuelson theorem, the decrease in p_1/p_2 increases the interest rate at home when labor is perfectly mobile. In the foreign country, the decrease in p_1/p_2 reallocates factors from the labor intensive sector to the capital intensive sector. As one unit of labor moves from sector 1 to sector 2, less capital would be released in sector 1 than can be absorbed in sector 2 if capital intensities in both sectors were to remain constant. Therefore, as a consequence of the labor adjustment, capital intensities must decrease in both sectors. The rigid labor market in the foreign country, however, prevents a required labor adjustment and the reduction in capital intensities (an increase in the interest rate) to the full scale. Therefore, without any cross-country capital movement, the foreign interest rate would be lower than the domestic interest rate. With capital mobility, the home country runs a current account deficit in period t.

Intuitively, for a country to avoid using the current account to adjust to a shock, it has to do all the adjustment through a change in the composition of goods trade (exporting more the labor-intensive good and importing more the capital-intensive good). For a large country (e.g., the United States) to be able to do that, the rest of the world would have to do the reverse (adjusting its output mix and composition of goods trade in the opposite direction). Any lack of labor market flexibility in the rest of the world would prevent it from adjusting the output mix and the composition of goods trade fully. As a consequence, the large country with a perfectly flexible labor market would have to adjust to a shock at least partly through its current account if the labor market in the rest of the world is not perfectly flexible. We state the result as follows and a mathematical proof can be requested from the authors.

Proposition 6 *Consider a two-country world (i.e., both countries are large) in which the labor market is perfectly flexible at home* ($\lambda = 1$) *but somewhat rigid in the foreign country*($\lambda^* < 1$). *When the home country's aggregate technology improves sufficiently at period* $t+1$, *it experiences an inflow of capital (i.e., runs a current account deficit).*

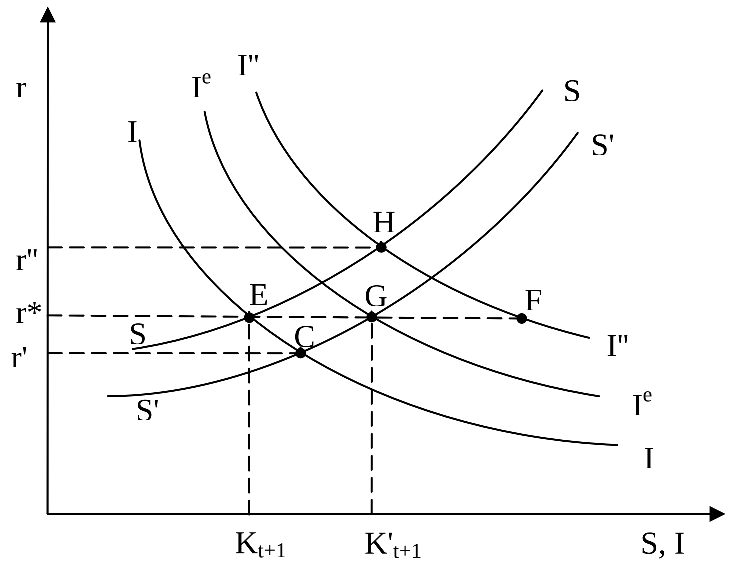

Figure 1

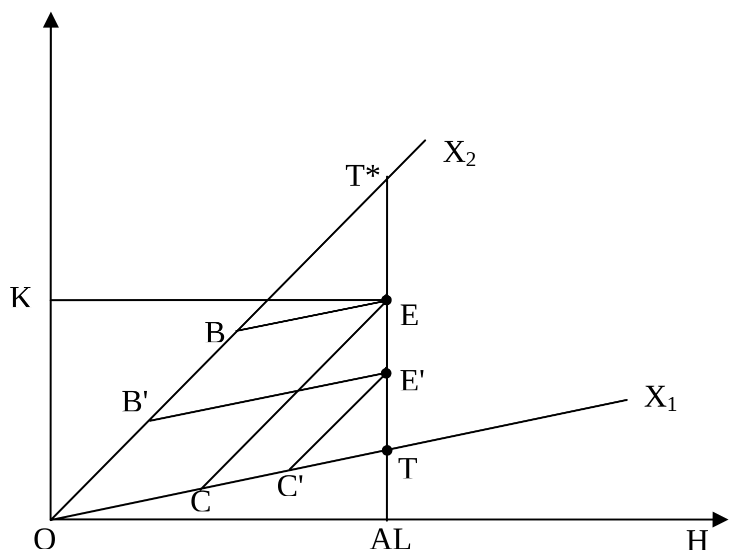

Figure 2

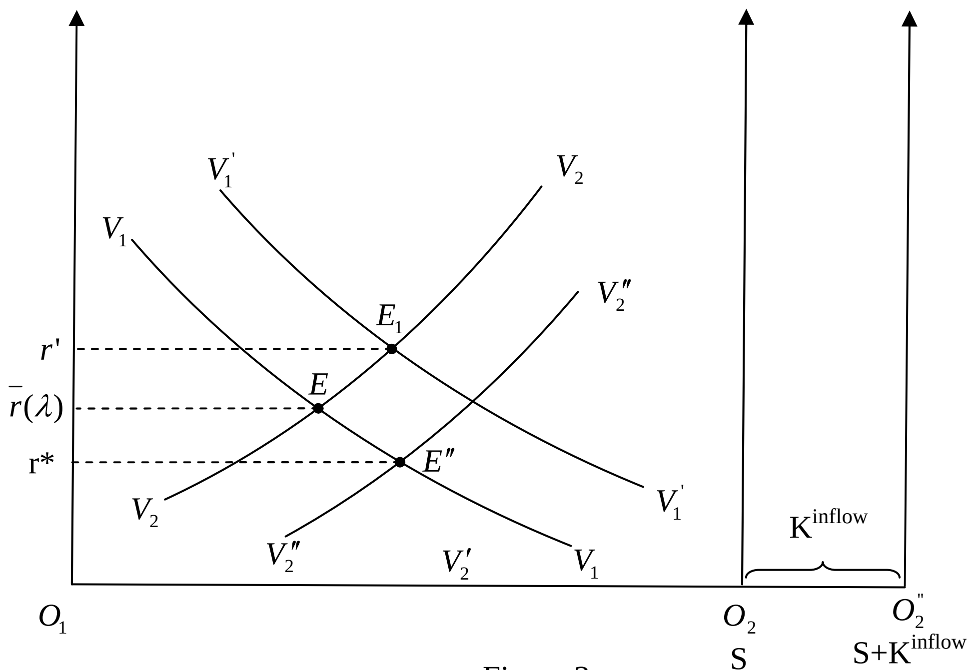

Figure 3