Current Account Adjustment: Some New Theory and Evidence

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Abstract

This paper aims to provide a theory of current account adjustment that places domestic labor market institution in the center stage. It nests the textbook version of the intertemporal approach as a special case. In general, in response to a shock, an economy adjusts through a combination of a change in the composition of goods trade (i.e., intra-temporal trade channel) and a change in the current account (i.e., intertemporal trade channel). The more rigid the labor market, the slower the speed of adjustment of the current account toward its long-run equilibrium. Three pieces of evidence are provided that are consistent with the theory.

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1 Introduction

One of the major advances in open-economy macroeconomics is an intertemporal approach to current account, developed in seminal work by Sachs (1981, 1982) and Svesson and Razin (1983), codified in Obstfeld and Rogoff (1996), and now taught to every graduate student in international economics. Relative to the Mundell-Fleming model, the intertemporal approach has a micro-foundation and can be connected to Friedman's permanent income hypothesis. In spite of its appeal at a conceptual level and some partial empirical support, actual current accounts for many countries appear too smooth (i.e., do not seem to move as much as the theory would predict) (see, for example, Roubini, 1988; Sheffrin and Woo, 1990; Otto, 1992; Ghosh, 1995; Ghosh and Ostry, 1995; Obstfeld and Rogoff 1996; and Hussein and de Melo, 1999). Sometimes, the empirical failure of the classic intertemporal approach is interpreted as a consequence of barriers to capital flows. The difficulty with this interpretation is that the empirical failure occurs also with countries that have arguably a very high degree of capital mobility (e.g., the United Kingdom, see Sheffrin and Woo, 1990, and Obstfeld and Rogoff, 1996). In this paper, we aim to propose a theory of current account adjustment that nests the textbook version as a special case. Even without barriers to capital flows, countries with certain institutional features (to be made clear later) would naturally have relatively smooth current accounts. We also provide some evidence, not previously examined in the literature, that is consistent with the theory's predictions.

We argue that the setup of a single tradable-sector in a typical paper on the intertemporal approach is not an innocuous simplification. In particular, in an alternative setup with two tradable sectors, any shock that changes a country's capital stock - which can come from an exogenous increase in the domestic capital stock, an increase in the discount factor, or an increase in productivity - could be accommodated by a change in the composition of output and intra-temporal trade with no need for a current account adjustment (or intertemporal trade). The intuition behind this apparently major departure from the classic exposition of the intertemporal approach can be understood by appealing to the classic theory of (intra-temporal) trade. In the Heckscher-Ohlin-Samuelson model with two sectors and two factors, factor prices are equalized across countries as long as the goods market is integrated. Even with financial autarky (i.e., no intertemporal trade but with free trade in goods), a shock to capital stock can be completely accommodated by a change in the composition of output and goods trade. Instead of exporting capital directly (i.e., adjusting the current account), a country can export capital indirectly by exporting more of the capital-intensive product and at the same time importing more of the labor-intensive product (i.e., adjusting the composition of the intra-temporal trade). In this case, going from financial autarky to free international capital mobility may not generate any actual capital movement. So intertemporal trade is completely substituted by intra-temporal trade.[1]

Of course, current account does fluctuate in the data; so one cannot stop here. Can we recover the textbook predictions about a current account response to shocks in our model with multiple tradable goods? The answer is yes if we assume that labor is sector-specific. In particular, if labor is not mobile across sectors, then domestic output composition cannot change fully in response to a shock to a country's capital stock, and the current account response would resemble those in the textbook by Obstfeld and Rogoff (1996). In general, if labor market rigidity is somewhere between zero and infinity, the economy's response to a shock would be through a combination of a change in the current account (i.e., the intertemporal trade channel) and a change in the composition of output and goods trade (i.e., the intra-temporal trade channel). As an implication, the size of a current account response to a shock tends to be smaller than predicted by the textbook version of

[1] The substitutability between international trade and factor mobility is pioneered by Mundell (1957), and discussed by Jones and Neary (1984), Markusen (1983), Markusen and Svensson (1985), Wong (1986), and Neary (1995), among many others.

the intertemporal approach. The relative importance of the intertemporal trade channel as an adjustment mechanism to a shock depends inversely on the degree of domestic labor market flexibility. As far as we know, this paper represents the first model in the literature that makes a connection between domestic labor market institutions and the pattern of current account adjustment.

We provide three pieces of evidence from the data. First, we report evidence that an economy's frequency in the adjustment of the trade composition is linked to its labor market rigidity. This is a necessary but not sufficient condition for our story. Second, we test a time-series interpretation of our theory. Specifically, by analogy of the literature on goods trade, labor is considered sector specific in the very short run but fully mobile across sectors in the very long run. The time it takes for an economy to move from the short run equilibrium (where the initial response to a shock is a change in the current account) to the long run equilibrium (where the adjustment is accomplished through a change in the composition of output and goods trade and the current account returns to its steady-state level) is interpreted as proportional to labor market rigidity. This ties in with an empirical literature in open-economy macroeconomics that estimates the speed of adjustment of the current account towards the long-run equilibrium (Milesi Ferretti-Razin, 1988; Freund, 2000; Freund and Warnock, 2005; and Clarida, Goretti, and Taylor, 2005). Typically, this line of research finds that the current account has a tendency to regress back to its long-run equilibrium, but the speed of adjustment is heterogenous across countries. The reason behind the cross-country heterogeneity is not typically explored, and the estimation is not typically based on any theory. Our theory suggests that we should link the speed of current account adjustment with an economy's labor market rigidity. We thus implement our empirical test in two steps: (a) estimating a speed of current account adjustment country by country; and (b) relating the adjustment speed to labor market rigidity. The result is supportive of our prediction, namely, that the current account tends to adjust faster to the long-run equilibrium for an economy with a more flexible labor market. Third, we report evidence that a country's current account (relative to total trade) is more variable if its labor market is less flexible.

The large country case represents an interesting twist. Since one country's current account surplus must be the rest-of-the-world's current account deficit, for a large country, its current account adjustment depends not only on its own labor market institutions, but also on those of other countries. We show theoretically that, even if a large country has a completely flexible labor market (but the rest of the world does not), part of its response to a shock to its capital stock has to take place through a change in its current account (which is different from the case of a small open economy).

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 with a model of one final good, two intermediate goods, and labor-augmenting technology. While this literature tends to focus on the question of income convergence across countries, current account adjustment is not typically studied (and a balanced trade is often *assumed*).

Our paper is also related to specific factor models in trade literature. Jones (1971), Mayer (1974), Mussa (1974), and Neary (1978 and 1995) are some of classic papers. The tradition in the trade literature is to assume that capital is sector specific but labor is fully mobile. Of course, collective bargaining and laws that make it difficult for firms to fire workers could impede labor mobility across sectors. More generally, both labor and capital may be specific in the very short run and become more flexible over time. In our context, since intertemporal trade is about capital mobility across countries, it would not be natural to let capital be mobile across countries but not within a country. In addition, impediments to labor mobility such as national laws and regulations are likely to have more variations across countries than impediments to capital mobility. We therefore focus on labor market rigidity in our model.

We organize the rest of the paper in the following way. Section 2 presents an overlapping-generation version of a multi-sector, two-factor, and flexible labor market model. After setting up the model, we first discuss how domestic interest rate under both trade and financial autarky (i.e., no goods trade and no international capital flows) would respond to various shocks (in a way that is parallel to the Obstfeld and Rogoff's (1996) exposition of the classic intertemporal approach to current account). The point is to demonstrate that the model behaves in the same way as the textbook model. However, when we allow for free trade in goods but retain financial autarky, the model deviates substantially from the textbook predictions. In particular, shocks to the economy are absorbed through changes in the composition of output and goods trade with no change in domestic interest rate. In this case, moving from financial autarky to financial openness would not generate any current account response to any of these shocks. Section 3 introduces 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-Samuelson model are special cases of the formulation. The last part of this section discusses how the large country case may differ from the small-country case. Section 4 presents some empirical work examining the relationship between domestic labor market institution and patterns of current account adjustment. Finally, Section 5 concludes and points to directions for future research.

2 An Overlapping-Generations, Multi-Sector Model

We use an overlapping-generations model to illustrate the idea and start with a closed-economy case. We assume that each individual lives for two periods, young and old. L_t individuals are born in period t. There is no population growth; thus $L_t = L_{t-1} = L$. Each individual supplies one unit of labor when he is young, and zero when he is old, and divides the labor income when young between his first period consumption and saving. In the second period, the individual consumes the saving (principle plus interest).

Let C_t^y and C_t^o be the consumption in period t of young and old individuals. The utility of an 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 time-preference factor.

Let w_t be the wage rate per unit of labor at period t and r_{t+1} the interest rate from period t to period $t+1$. The endowments of the economy at period t are labor L_t and capital stock K_t which equals the total saving from the previous period. L_t and K_t are used to produce two intermediate goods X_{1t} and X_{2t}, which in turn are used to produce a composite final good Y_t. The final good is then used for both consumption and investment. We assume that intermediate good 1, X_{1t}, is labor intensive, while X_{2t} is capital intensive. The final good is taken as the numeraire whose price is normalized to 1.

The intertemporal budget constraint is

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

The consumer maximizes utility (1) subject to the budget constraint (2). Substituting (2) into (1), the first order condition is:

$$\frac{\beta u'(C^o_{t+1})}{u'(C^y_t)} = \frac{1}{1+r_{t+1}} \tag{3}$$

which is the standard intertemporal Euler equation. (2) and (3) together solve for C^y_t and C^o_{t+1} as functions of (w_t, r_{t+1}, β). Individual's saving $s(w_t, r_{t+1}, \beta) = w_t - C^y_t(w_t, r_{t+1}, \beta)$. Thus, total saving in period t is given by

$$S_t(w_t, r_{t+1}, \beta, L_t) = [w_t - C^y_t(w_t, r_{t+1}, \beta)]\, L_t \tag{4}$$

In equilibrium S_t equals K_{t+1}, the capital stock in period $t+1$. $C^y_t(w_t, r_{t+1}, \beta)$ decreases as r_{t+1} increases. Thus $S_t(w_t, r_{t+1}, \beta, L_t)$ is an increasing function of r_{t+1}.

2.1 Production

The production setting assumed in this paper is close in spirit to Ventura (1997). 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 $X_{it} = f_i(A_t L_{it}, K_{it})$ where A_t measures labor productivity, which is exogenous and identical in both sectors[2]. $H_{it} = A_t L_{it}$ can be understood as *effective labor.* All production functions are assumed to be homogeneous of degree one. We assume no depreciation rate of capital for simplicity. The unit cost function for X_{it} is

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

We denote $q_t = w_t / A_t$ as the wage rate for one unit of effective labor thereafter.

[2] One could introduce the productivity parameter in a different way, e.g., making it Hicks-neutral in the final good, $Y_t = A_t G(X_{1t}, X_{2t})$. All major results in the current setup go through.

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

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

where p_i is the price of intermediate good i. Note that labor and capital are both used to produce intermediate goods. The full employment conditions for labor and capital are, respectively,

$$a_{1Lt+1}X_{1t+1} + a_{2Lt+1}X_{2t+1} = L_{t+1} \tag{7}$$

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

where $a_{iLt+1} = \frac{\partial\phi_i(q_{t+1},r_{t+1})}{A_{t+1}\partial q_{t+1}}$ and $a_{iKt+1} = \frac{\partial\phi_i(q_{t+1},r_{t+1})}{\partial r_{t+1}}$ are labor and capital usages per unit of production, respectively.

The profit maximization for final good producers requires

$$p_{1t+1} = G_1'(X_{1t+1}, X_{2t+1}) \text{ and } p_{2t+1} = G_2'(X_{1t+1}, X_{2t+1}) \tag{9}$$

which implies

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

$$= w_{t+1}L_{t+1} + r_{t+1}K_{t+1} \tag{11}$$

Equation (10) is due to homogeneous of degree one of $f(.)$ and implies zero profit for the final good producers. Equation (11) is due to zero profit for the intermediate goods producers and implies that the supply equals the demand in the final good market.

Equations (6)- (9) are a system of Heckscher-Ohlin-Samuelson (HOS) framework.

For a given vector of product prices (p_{1t+1}, p_{2t+1}), the factor prices (q_{t+1}, r_{t+1}) are determined by (6). Given the factor prices, the endowment vector (L_{t+1}, K_{t+1}) then determines the output vector (X_{1t+1}, X_{2t+1}) through equations (7) and (8). Finally, the product prices (p_{1t+1}, p_{2t+1}) and the sector outputs are also linked by the market clearing condition (9) for the products. All the key propositions of the HOS model hold here. In particular, Samuelson's factor price equalization theorem holds: If the product prices (p_{1t+1}, p_{2t+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.

If K_{t+1} increases, the Rybczynski theorem implies that the capital intensive output X_{2t+1} increases, while labor intensive output X_{1t+1} decreases. Thus the market price of X_{2t+1}, p_{2t+1}, declines, while p_{1t+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, $r(L_{t+1}, K_{t+1})$ as a solution to the above system is a decreasing function of K_{t+1}. The inverse function of this,

$$K_{t+1} = I(L_{t+1}, r_{t+1}) = r^{-1}(L_{t+1}, r_{t+1}) \tag{12}$$

defines the investment function. Since the wage rate $w_{t+1} = A_{t+1}q_{t+1}$, an improvement in the (labor-augmenting) productivity increases the wage rate proportionally. However, the interest rate r_{t+1}, and the investment function $r^{-1}(L_{t+1}, r_{t+1})$ are not affected by a change in the technology A_{t+1}.

2.2 Interest Rate under Trade and Financial Autarky

The equilibrium interest rate in period $t+1$, r_{t+1}, is determined by the saving function (4) (the supply of capital) and the investment function (12) (the demand for capital). This can be represented graphically by a Metzler diagram in Figure 1A that has saving and investment on the horizontal axis and interest rate on the vertical axis. The upward-sloping SS curve represents the saving function and the downward-sloping II curve represents the investment function. The equilibrium investment K_{t+1} and interest rate r_{t+1} are at the intersection between the SS and II curves. We consider four cases of comparative statistics under autarky (with neither goods trade nor international capital flows): an increase in the capital stock in period t, the time preference, the productivity shifter in period t and the productivity shifter in period $t+1$, respectively. The objective is to show that our model in this case behaves the same way as the textbook model with one tradable sector.

2.2.1 Change in Capital Stock K_t

Consider an exogenous increase in the capital stock in period t (possibly due to an infusion of international aid). We apply the standard HOS analysis to equilibrium conditions (6) - (9). The increase in K_t results in a reduction in the interest rate r_t and an increase in the effective wage rate q_t. Thus, wage rate in period t, $w_t = A_t q_t$, increases.

Note that individual saving $s(w_t, r_{t+1}, \beta) = w_t - C_t^y(w_t, r_{t+1}, \beta) = \frac{C_{t+1}^o(w_t, r_{t+1}, \beta)}{1+r_{t+1}}$. As wage income w_t increases, $s(w_t, r_{t+1}, \beta)$ increases. Therefore, in Figure 1a, the saving curve SS shifts out, while the investment curve II. The equilibrium moves from E to C and r_{t+1} declines.

2.2.2 Change in Time Preference β

An increase in β in period t means that individuals have become more patient and would like to consume less in period t but more in the next period. Thus, $s(w_t, r_{t+1}, \beta) = \frac{C_{t+1}(w_t, r_{t+1}, \beta)}{1+r_{t+1}}$ increases and the saving curve SS shifts out. The demand for capital or the investment curve II in $t+1$ is not affected. So we have a lower r_{t+1}.

2.2.3 Change in Productivity

Consider first an increase in A_t. In response, $w_t = A_t q_t$ must increase proportionally. Thus, the saving curve SS in period $t+1$ shifts out, while the investment curve II in period $t+1$ is not affected. As a result, r_{t+1} declines.

Consider next an increase in A_{t+1}. In our setup, this has no effect on the wage income in period t, and therefore no effect on the saving curve SS. As we discussed before, in this *labor-augmenting* setup, an increase in A_{t+1} has no effect on the investment curve II either. Thus, r_{t+1} does not change.

2.3 Two Ways Out of Trade/Financial Autarky

Let us now consider the open-economy case in which the world consists of two countries, home and foreign, and allows for both intratemporal and intertemporal trade. The intratemporal trade takes place when a country exports the good of its comparative advantage and imports the good of its comparative disadvantage. The intertemporal trade 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.

Note that in the textbook exposition of the intertemporal approach, since there is only one tradable sector, only intertemporal trade but no intratemporal trade is feasible. For comparison, we first discuss how our model would work if intratemporal trade in the intermediate goods is artificially banned. Assume that the two countries are identical to begin with, and then the home country is hit by a shock that increases K_t, β, A_t or A_{t+1}, respectively. All foreign variables are denoted by a "*". The current account balance is illustrated in Figure 1. As we discussed in the last section, an increase in either K_t, β, or A_t would shift the saving curve in period $t+1$ out from SS to $S'S'$, while the investment curve II remains unchanged. The post-shock home autarky interest rate, $r^{A\prime}_{t+1}$, is at point C and less than that of abroad at E^*, r^{A*}_{t+1}. Thus, if only the intertemporal trade is allowed, the world interest rate r is above $r^{A\prime}_{t+1}$ but below r^{A*}_{t+1}. Home would run a current account surplus in period t, and foreign would run a deficit. These results resemble exactly those in Obstfeld and Rogoff (1996). An improvement in the future technology A_{t+1} is only slightly different. In the textbook, this shifts out both the saving curve SS and the investment curve II so the net effect on the interest rate is ambiguous. In our model, an increase in A_{t+1} has no effect on either the saving curve SS or the investment curve II, and therefore no effect on the interest rate.

Suppose we now allow for free trade in intermediate and final goods, but ban intertemporal trade. We will see that our model's results can be dramatically different from those in Obstfeld and Rogoff (1995). The intratemporal trade in the intermediate and final good equalizes the product prices across countries in every period. That is, $p_{it} = p^*_{it}$. As equation (6) and the counterpart in foreign country indicate, the factor prices (q_t, r_t) are determined by the prices of intermediate goods (p_{1t}, p_{2t}) so we must have

$$q_t = q^*_t \text{ and } r_t = r^*_t \tag{13}$$

in every period t. Consider now opening up the economy for international capital flows. With equal interest rates in both countries, there is no incentive for intertemporal trade.

This is basically Samuelson's factor price equalization theorem. The underlying reason for the difference between our setup and that in Obstfeld and Rogoff (1995) is that an extra channel for adjustment to shock - through intratemporal trade in the intermediate goods - has been opened up. In particular, in response to a shock that increases the home country's capital stock, instead of exporting capital directly (i.e., through current account adjustment), the home country can increase the production and exports of the capital intensive intermediate good (i.e., exporting capital indirectly through intratemporal trade).

This idea can be illustrated by the Metzler diagram. In Figure 1, as we have analyzed in the last section a shock that augments the home country's capital stock would shift out the home saving curve from SS to $S'S'$. Let I^eI^e and $I^{e*}I^{e*}$ be the post-shock investment curves at home and abroad, respectively. As Home produces more capital intensive good now than under autarky, and Foreign produces less, the home investment curve I^eI^e in Figure 1A shifts out, but the foreign investment curve $I^{e*}I^{e*}$ in Figure 1B shifts in. The intratemporal trade moves the domestic equilibrium from C to G, and the foreign equilibrium from E^* to G^*. The interest rates after the intratemporal trade are again equalized in the two countries.

The following proposition summarizes our discussion:

Proposition 1 *In a frictionless world, intratemporal trade in the intermediate goods equalizes the interest rates across countries in every period. As a result, there is no incentive for intertemporal trade.*

2.4 Multiple Equilibria

Going from trade/financial autarky to an open economy, zero intertemporal trade (or zero capital flow) is a possible equilibrium but not the only one. To see this, we use a graphical representation of an integrated world economy from Dixit and Norman (1980) and Helpman and Krugman (1985). In Figure 2, O and O^* represent the origins for home and foreign countries, respectively. Vectors OX_1 and OX_2 represent the world employment of capital and labor in intermediate Sectors 1 and 2 in the equilibrium of the integrated world economy. Intratemporal trade equalizes product and factor prices across two countries. Let E be the distribution of factor endowments without capital flow. That is, $E = (L_{t+1}, K_{t+1})$ from origin O and $\left(L^*_{t+1}, K^*_{t+1}\right)$ from origin O^*. The full employment conditions in home country, (7) and (8), determine the domestic employment of labor and capital in Sector 1 and 2, OA and OB, respectively. O^*A^* and O^*B^* are their foreign-country counterparts. Note that any distribution inside the parallelogram $OX_1O^*X_2$ is an possible equilibrium if both labor and capital are mobile internationally. If labor is not internationally mobile (which we will assume throughout the paper), all points on line TT^* are equilibria. For example, point E' where home lends EE' amount of capital to foreign, and produces OA' and OB', is one of the feasible equilibria.

Multiple equilibria implies indeterminacy. To achieve a unique equilibrium, we consider first costs of goods trade together with costs of capital flows. This would result in a complete specialization in either intratemporal trade or intertemporal trade. We regard this as unsatisfactory as it is not consistent with the data. Our preferred solution is to relax the assumption of perfect labor mobility within a country. That we will discuss in Section 3.

2.5 Adding Costs to Goods Trade and Capital Flows

In an influential paper by Obstfeld and Rogoff (2000), trade costs are used to explain the Feldstein-Horioka puzzle, as well as other five major puzzles in international finance. It is argued that "trade costs can create a wedge between the effective real interest rates faced by borrowers and lenders," and "it is precisely such incipient real-interest-rate effects that keep observed current-account imbalances within a modest range." (Obstfeld and Rogoff 2000, pp. 341) In this section, we introduce costs of trade into our multiple-sector model and study the effect of trade costs on current account. As we will see, our results are very different from those of Obstfeld and Rogoff (2000).

Consider the case in which a shock increases the domestic capital stock at $t+1$ in the world with two otherwise identical countries. That is, $K_{t+1} > K^*_{t+1}$. Home is capital abundant, importing labor-intensive intermediate good 1 and exporting capital-intensive intermediate good 2. We assume an iceberg transportation cost τ: for every unit of home (foreign) good shipped abroad, only a fraction $1-\tau$ arrives. Then the no-arbitrage condition implies that

$$p_{1t+1} = \frac{p^*_{1t+1}}{1-\tau} \text{ and } p_{2t+1} = (1-\tau)\, p^*_{2t+1} \tag{14}$$

For simplicity, we assume a Cobb-Douglas production function for both intermediate goods so that $\phi_i(q_{t+1}, r_{t+1}) = q_{t+1}^{\alpha_i} r_{t+1}^{1-\alpha_i}$ where $\alpha_1 > \alpha_2$. Rewrite the zero profit conditions for home and foreign countries

$$\begin{aligned} p_{1t+1} &= q_{t+1}^{\alpha_1} r_{t+1}^{1-\alpha_1} \text{ and } p_{2t+1} = q_{t+1}^{\alpha_2} r_{t+1}^{1-\alpha_2} \\ (1-\tau)\, p_{1t+1} &= q_{t+1}^{*\alpha_1} r_{t+1}^{*1-\alpha_1} \text{ and } \frac{p_{2t+1}}{(1-\tau)} = q_{t+1}^{*\alpha_2} r_{t+1}^{*1-\alpha_2} \end{aligned} \tag{15}$$

which gives

$$\frac{r_{t+1}}{r_{t+1}^*} = (1-\tau)^{\frac{\alpha_1+\alpha_2}{\alpha_1-\alpha_2}} \tag{16}$$

We also assume an iceberg cost of capital flow, ρ. Hence, capital flows from country to foreign countries if

$$\frac{r_{t+1}}{r_{t+1}^*} < (1-\rho) \tag{17}$$

Combining (16) and (17), we conclude that there would be no capital flow (intertemporal trade) if trade costs are small relative to costs of capital flows in the sense that $\tau < 1 - (1-\rho)^{\frac{\alpha_1-\alpha_2}{\alpha_1+\alpha_2}}$. In this case, any cross-country interest rate differential would be driven down sufficiently by the trade in intermediate goods so that no international capital flow (or intertemporal trade) would take place.

On the other hand, if $\tau > 1 - (1-\rho)^{\frac{\alpha_1-\alpha_2}{\alpha_1+\alpha_2}}$, there would be capital flows (from home to foreign country). Note that as long as there exists intratemporal trade, (16) always holds and $r_{t+1} < (1-\rho)\, r_{t+1}^*$. In this case, enough capital would cross the national border until the capital/labor ratios in the two countries become identical so that intratemporal trade is eliminated. This is essentially Mundell's (1957) argument that intertemporal trade (capital flow) intratemporal trade are substitutes.

The notion of trade costs includes transport cost, tariffs and non-tariff barriers. Costs of capital flows include costs associated with exchange controls, foreign countries' taxes on international investment, and premium for currency and political risks in international financial investment. Given the strong home bias on observes in international financial investment, it is entirely possible that the cost of international capital flows is enormous for many countries. The following proposition summarizes our discussion.

Proposition 2 *Introducing costs of trade and costs of capital flow produces a unique equilibrium but at one of the two corners. If the trade cost is small relative to the cost of capital flow in the sense that* $\tau < 1 - (1-\rho)^{\frac{\alpha_1 - \alpha_2}{\alpha_1 + \alpha_2}}$, *then the economy's adjustment to a shock to capital stock takes place entirely through intratemporal trade in the intermediate goods (i.e., no current account response). On the other hand, if the trade cost is large relative to the cost of capital flow, then the adjustment to a shock takes place entirely through intertemporal trade (or capital flow).*

By construction (with only one tradable sector), Obstfeld and Rogoff (2000) rule out intratemporal trade in the intermediate goods. In their model a higher transportation cost raises incipient real interest differentials and therefore increases the cost of borrowing/lending (i.e. current account adjustment), which reduces the current account imbalance. In contrast, in our model, there would be no incentive for international capital flow if the trade cost were zero, since the intratemporal trade in goods would have indirectly realized trade in capital. Thus, our model produces the opposite result from Obstfeld and Rogoff with regard to the effect of trade costs on the size of current account. Obstfeld and Rogoff (2000) report a negative empirical correlation between current account surplus and real domestic interest rate and interpret that as supportive evidence for their theory. However, the negative correlation is also consistent with our model except that the direction of causality is reversed.

3 A Model with Labor Market Rigidity

We now turn to a model that allows for labor market rigidity. In the Heckscher-Ohlin-Samuelson framework described above, it is assumed that capital and labor can be costlessly and instantaneously reallocated between sectors within a country. We now relax this assumption. With some degree of labor market rigidity, we will show that the equilibrium is again unique (even if there is zero cost of trade and zero cost of capital flow). Generally speaking, in response to a shock, an economy's adjustment involves a combination of intratemporal trade (i.e., a change in the production mix and the quantity of trade in the intermediate goods) and intertemporal trade (i.e., borrowing or lending on the international capital market). To focus the attention on the effect of labor market rigidity on patterns of adjustment, we assume away costs of trade and capital flow in this section.

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 at $t+1$ have made career choices in terms of which sector to work in. L_{it+1} is hired in sector i at time $t+1$, and the capital stock is K_{t+1} without shock. Then a shock (e.g., a change in K_t, β, or A_t) hits the economy. To simplify the analysis, we assume that the intratemporal trade is balanced initially and no capital moves across countries in equilibrium in period t. Note that since the intratemporal trade in the intermediate goods equalizes the interest rates across countries, no capital flow does not imply capital/labor ratios are identical between two countries to begin with. The home country - to be hit by a shock by assumption - can well be a labor abundant country. If home is a small country, it is shown that capital will flow from home to foreign countries in period t although the home country may export capital intensive good at the same time. We will relax the small country assumption and discuss the large country case at the end of this section.

3.1 Current Account Adjustment in a Small Country

Let home be a small country and takes world prices (p_{1t}, p_{2t}) as given. When labor is perfectly mobile across sectors, we would want our model to coincide with the HO setup discussed in Section 2.1. Domestic factor prices (q_{it+1}, r_{it+1}) would be equal to world prices (q^*_{t+1}, r^*_{t+1}) and determined by (6) both before and after the shocks. If labor in sector i is fixed, on the other hand, this will become a specific-factor model. An increase in capital stock would reduce the interest rate, but raise wage rate in sector i. The wage rate in capital intensive sector, w'_{2t+1}, would be higher than the wage rate in labor intensive sector, w'_{1t+1}. Outputs in both sectors would increase. As in textbook exposition of trade theories, the specific-factor model is viewed as a short-run equilibrium, and the economy adjusts gradually to the HO equilibrium in the long run. Along the adjustment path, labor (and capital) will flow from labor-intensive sector to capital-intensive sector. In the end, the factor prices go back to world levels, and the capital-intensive output will increase, but the labor intensive output will decrease, as predicted by the Rybczynski theorem.

Between these two polar cases, there can be an intermediate level of labor market rigidity. To parameterize the degree of labor market rigidity, we assume for one unit of labor transferred from one sector to another, only a fraction λ of productivity is preserved where $0 \leq \lambda \leq 1$. Hence, $1-\lambda$ of productivity is sector specific and is lost during labor adjustment. A higher λ represents a less rigid labor market. At the one extreme, $\lambda = 1$ represents the HO model; at the other extreme, $\lambda = 0$ represents the specific-factor model. The post-shock wage ratio in the specific-factor model, $\frac{w'_{1t+1}}{w'_{2t+1}}$, gives the upper bound for wage differential between two sectors. Therefore, if $\lambda \leq \frac{w'_{1t+1}}{w'_{2t+1}}$, an individual moving from sector 1 to sector 2 would see a decline in her wage income. As a result, no labor flows between sectors and the wage rates are stuck at (w'_{1t+1}, w'_{2t+1}). If $\lambda > \frac{w'_{1t+1}}{w'_{2t+1}}$, labor will move from sector 1 to sector 2 until $w_{1t+1} = \lambda w_{2t+1}$. Summarizing the discussion, we have:

$$w_{1t+1} = \begin{cases} \lambda w_{2t+1}, & \frac{w'_{1t+1}}{w'_{2t+1}} < \lambda \leq 1 \\ w'_{1t+1}, & 0 \leq \lambda \leq \frac{w'_{1t+1}}{w'_{2t+1}} \end{cases}$$

and $w_{1t+1} = w_{2t+1} = w^*_{t+1}$ when $\lambda = 1$. Since an change in the labor market rigidity has no effect on the economy when $\lambda \leq \frac{w'_{1t+1}}{w'_{2t+1}}$, we will consider the case that $\frac{w'_{1t+1}}{w'_{2t+1}} < \lambda \leq 1$ thereafter.

Let $f_i(A_{t+1}L_{it+1}, K_{it+1})$ be the production function for intermediate good i and we drop the subscript $t+1$ in the rest of this subsection for simplicity. Note that $q_i = Aw_i$ so $w_1 = \lambda w_2$ if and only if $q_1 = \lambda q_2$. The equilibrium conditions become:

$$p_1 \frac{\partial f_1(H_1, K_1)}{\partial K_1} = p_2 \frac{\partial f_2(H_2, K_2)}{\partial K_2} \tag{18}$$

$$p_1 \frac{\partial f_1(H_1, K_1)}{\partial H_1} = \lambda p_2 \frac{\partial f_2(H_2, K_2)}{\partial H_2} \tag{19}$$

$$H_1 + H_2 = AL, \text{ and } K_1 + K_2 = K' \tag{20}$$

Equation (18) states that the marginal products of capital in both sectors are equalized, while equation (19) is the condition that $w_{1t+1} = \lambda w_{2t+1}$.

We are now ready to discuss the open-economy case. The distribution of capital and the level of interest rate are depicted in Figure 3. 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 in sector 1 and 2, labeled as V_1 and V_2 respectively, are plotted relative to origins O_1 and O_2. The equilibrium position before a shock is shown by E^0 where $V_1^0 = p_1 \partial f_1(H_1^0, K_1)/\partial K_1$ and $V_2^0 = p_2 \partial f_2(H_2^0, K - K_1)/\partial K_2$ intersect. Consider a shock that increases the capital stock from K to K', so that origin O_2 is shifted to the right to O'_2 by $\Delta K = K' - K$. Correspondingly, V_2^0, is shifted to the right by an amount of ΔK and represented by $V_2^{'} = p_2 \partial f_2(H_2^0, K' - K_1)/\partial K_2$. In the specific-factor model when labor is not mobile ($\lambda \leq \frac{w'_{1t+1}}{w'_{2t+1}}$), the new equilibrium E' is determined by the intersection between V_1^0 and $V_2^{'}$. The interest rate decreases from r^* to r' and capital employed in sector 1,

K_1, increases from K_1^0 to K_1^1. At the constant product prices, the wage rate in each sector must increase and by a greater proportion in the capital intensive sector. In the long-run which can be thought as $\lambda = 1$, factor prices are restored to (w^*, r^*). Using Rybczynski theorem, the output of the labor intensive sector must fall. That is, both V_1 and V_2 shift to the left and intersect at the long-run equilibrium E^L (not drawn), which is to the left of point E^0.

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 would generate some paradoxical results in comparative statics. To simplify the analysis, we will assume a Cobb-Douglas production function thereafter, which avoids these paradoxes. More precisely, let

$$f_1(H_1, K_1) = (H_1)^{\alpha_1} K_1^{1-\alpha_1} \text{ and } f_2(H_2, K_2) = (H_2)^{\alpha_2} K_2^{1-\alpha_2} \tag{21}$$

where $\alpha_1 > \alpha_2$. Therefore, sector 1 is more labor intensive than sector 2 in both physical and value sense.

When $\frac{w_1'}{w_2'} < \lambda < 1$, the equilibrium is described by equations (18), (19), and (20) and labelled as λ-economy. To distinguish, variables in λ-economy are denoted by superscript λ thereafter. The first set of comparative statics results, to be used later for our main results, are summarized in the following lemma. A formal proof is relegated to an Appendix.

Lemma 1 *Suppose that sector 1 is labor intensive in the λ-economy. Then we have $\frac{\partial H_1^\lambda}{\partial \lambda} < 0$, $\frac{\partial K_1^\lambda}{\partial \lambda} < 0$, $\frac{\partial r^\lambda}{\partial \lambda} > 0$, and $\frac{\partial r^\lambda}{\partial K} < 0$.*

Without capital flow, the equilibrium of the λ-economy, E^λ, is between the specific-factor equilibrium E' and the long run equilibrium E^L. V_2' shifts the left to $V_2^\lambda = p_2 \partial f_2(H_2^\lambda, K' - K_1)/\partial K_2$ and V_1^0 shifts left to $V_1^\lambda = p_1 \partial f_1(H_1^\lambda, K_1)/\partial K_1$ in Figure 3 since $H_1^\lambda < H_1^0$ but $H_2^\lambda = AL - H_1^\lambda > H_2^0$. As the labor market becomes less rigid, more factors flow from sector 1 to sector 2, both V_2^λ and V_1^λ will shift to the left further. The interest rate r^λ increases as λ increases so that $r' < r^\lambda < r^*$.

Wage rates are determined by (19) at E^{λ}. Thus, we have $w_1 = \lambda w_2$.

Because $r^{\lambda} < r^*$, domestic capital will flow out, which shifts both the origin O_2' and V_2^L to the right in Figure 3. As capital flows out, the home interest rate increases, while wage rate differential $w_2 - w_1$ shrinks so that $w_1/w_2 > \lambda$. This implies that labor in sector 1 will stop flowing to sector 2 after a sufficient amount of domestic capital flows out. Therefore, labor in each sector sticks to H_i^{λ} as capital flows. In the equilibrium the capital employed by home country is reduced to K'' and V_2^{λ} shifts left to $V_2'' = p_2 \partial f_2(H_2^{\lambda}, K'' - K_1)/\partial K_2$ which intersects V_1^{λ} at E''; the interest rate is restored to r^*. Using zero profit condition that $p_1 = \phi_1(w_1^{\lambda}/A, r^{\lambda})$ and $p_2 = \phi_2(w_2^{\lambda}/A, r^{\lambda})$, it is immediately seen that $r^{\lambda} = r^*$ ensures that $w_1^{\lambda} = w_2^{\lambda} = w^*$ at equilibrium E''.

Let $B = K' - K''$ denote the amount of capital outflow. The interest rate is determined by the labor market rigidity λ and the capital stock employed at the home country K''. That is, $r^{\lambda} = r^{\lambda}(\lambda, K'') = r(\lambda, K' - B)$. The home interest rate increases as λ increases or K'' decreases (B increases). Thus, the amount of capital outflow is determined by

$$r^{\lambda}(\lambda, K' - B) = r^* \tag{22}$$

Differentiating the equation (22), we immediately have

$$\frac{dB}{d\lambda} = \frac{\frac{\partial r^{\lambda}(.)}{\partial \lambda}}{\frac{\partial r^{\lambda}(.)}{\partial K}} < 0 \tag{23}$$

We summarize our results by the following proposition.

Proposition 3 *When a shock increases the capital stock in the home country with a labor market flexibility indexed by λ, capital flows out and the home country runs a current account surplus in period t. The higher the value of λ (i.e., the more flexible the labor market), the smaller the current account response to the shock.*

When a shock reduces the capital stock in the home country, the wage rate in sector 1 will be higher than that in sector 2. A similar argument shows that the country will run a current account deficit in period t, and the CA deficit becomes smaller if the labor market is less rigid.

We can also assign a time-series interpretation to the proposition. In the very short run, any economy can be thought of as represented by $\lambda = 0$ and its adjustment to a shock takes the form of a change in the current account. In the long run, any economy can be thought of as represented by $\lambda- > 1$ and its adjustment to a shock takes the form of a change in the output mix and the composition of the goods trade and no change in the current account. Cross-country differences in labor market flexibility are then reflected in the cross-country differences in the speed of adjustment of the current account to its long-run steady state after a shock.

As the labor market becomes less rigid ($\lambda \to 1$), the CA balance in a small country tends to zero. This discussion, however, ignores the effect of a change in domestic variables on the world price. To take such an effect into consideration, we have to consider the case of a large country.

3.2 Current Account Adjustment in a Large Country

As the capital stock increases from K to K' at home, the relative supply of labor intensive good to capital intensive good, X_1/X_2, declines. As the result, the world relative price of good 1, p_1/p_2, increases. Therefore, in the foreign country, sector 1 expands relative to sector 2 and the wage rate in sector 1, w_1^*, is higher than that in sector 2, w_2^*. The counterparts of equilibrium conditions (18), (19), and (20) in the foreign country are:

$$p_1 \frac{\partial f_1(H_1^*, K_1^*)}{\partial K_1^*} = p_2 \frac{\partial f_2(H_2^*, K_2^*)}{\partial K_2^*} \tag{24}$$

$$\lambda^* p_1 \frac{\partial f_1(H_1^*, K_1^*)}{\partial H_1^*} = p_2 \frac{\partial f_2(H_2^*, K_2^*)}{\partial H_2^*} \tag{25}$$

$$H_1^* + H_2^* = A^* L^*, \text{ and } K_1^* + K_2^* = K^* \tag{26}$$

The labor market rigidity in the foreign country, λ^*, differs from that at home. Moreover, cross-sector factor adjustments in two countries goes in opposite directions. Sector 2 expands at home due to the increase in capital stock, but sector 1 expands in the foreign country due to the increase in the world market relative price for good 1. Equation (25) represents $w_2^* = \lambda^* w_1^*$ and is the reverse of equation (19). The market clearing conditions for the intermediate goods in the world are:

$$X_1(p_1, p_2) + X_1^*(p_1, p_2) = f_1(H_1, K_1) + f_1(H_1^*, K_1^*) \quad (27)$$

$$X_2(p_1, p_2) + X_2^*(p_1, p_2) = f_2(H_2, K_2) + f_2(H_2^*, K_2^*) \quad (28)$$

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 (9), and $X_i^*(p_1, p_2)$ is its counterpart in the foreign country.

First consider the intratemporal equilibrium without capital flow. Ten endogenous variables, H_1, K_1, H_2, K_2, H_1^*, K_1^*, H_2^*, K_2^*, p_1, and p_2 are determined by ten equations (18), (19), (20), (24), (25), (26), (27), (28). By comparing domestic interest rate r, which is determined by K_1/H_1, with the foreign interest rate r^*, which is determined by K_1^*/H_1^*, we can determine the direction of capital flow.

Now let K^f be the amount of capital flow (intertemporal trade) between the countries. The equilibrium of intratemporal and intertemporal trades is then determined by the ten equations described above, replacing domestic and foreign capital stocks, K' and K^*, by $K' - K^f$ and $K^* + K^f$, respectively, and adding a world capital market clearing condition:

$$p_1 \frac{\partial f_1(H_1, K_1)}{\partial K_1} = p_1 \frac{\partial f_1(H_1^*, K_1^*)}{\partial K_1^*} \quad (29)$$

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 level domestic and foreign interest rates and the qualitative results of Proposition 3 remains. Using Stolper-Samuelson theorem, the increase in p_1/p_2 decreases the interest rate at home when labor market is perfectly mobile. In the foreign country, the increase in p_1/p_2 reallocates factors from the capital intensive sector to the labor intensive sector. As one unit of labor flows from sector 2 to sector 1, more capital would be released in sector 2 than can be absorbed in sector 1 if the capital intensities in both sectors were to remain constant. Therefore, as a consequence of the labor adjustment, the capital intensities must rise in both sectors. The rigid labor market in the foreign country, however, prevents a required labor adjustment and therefore an increase in capital intensities (a decrease in the interest rate) to the full scale. Therefore, without any cross-country capital movement, the foreign interest rate would be higher than the domestic interest rate. With capital mobility, the home country runs a current account surplus 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 capital-intensive good and importing more the labor-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 relegate a formal proof to the appendix.

Proposition 4 *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 a shock increases the capital stock in the home country, the home country runs a current account surplus in period t.*

This proposition suggests that the relationship between labor market flexibility and current account adjustment for a large country is qualitatively different from a small country. For a small country, the more flexible the domestic labor market, the faster the speed of convergence of the current account toward its long-run steady state. But this feature may not hold for a large country.

4 Some Empirical Evidence

In this section, we investigate three questions empirically for small open economies. First, does the flexibility of a country's labor market correspond to the flexibility of its trade structure? Second, does labor market rigidity slow down the speed of convergence of an economy's current account to its long-run equilibrium? Third, is a rigid labor market associated with a greater variance of the current account relative to total trade?

These three questions are inter-related. In our theory, flexibility of domestic labor market affects an economy's ability to use a change in the composition of goods trade rather than a change in the current account to accommodate a shock. Hence, a necessary condition for our story to work is that flexibility in a country's labor market should be reflected in the flexiblity of its trade structure. We note, however, this is not a sufficient condition for our story as other theories could also be consistent with this pattern[3].

The second question examines an implication of our theory for the dynamics of current account. In the very short run, an given economy may be represented by a

[3] See, for example, Cunat and Melitz (2007).

specific-factor model ($\lambda = 0$). According to our theory, the entire adjustment to a shock shows up in the current account. Over time, the economy converges toward a Hescher-Ohlin setup with a flexible labor market ($\lambda- > 1$). According to our theory, all the effect of the shock is absorbed in a change in the composition of goods trade and none in the current account. How fast the economy move from the very short run to the long run is dictated by the flexibility of its labor market. In this sense, our theory can be thought of as a micro-foundation for emprical estimations in the literature on the mean reversion property of the current account. Our theory predicts that the cross-country difference in labor market flexiblity is intimately linked to the cross-country hetergeneity in the speed of current account convergence to the long-run steady state. Following the theory by Kraay and Ventura (2000), we will not impose the restriction that the current account in the steady state is zero and let it be country specific instead.

The third question examines an implication of our theory for the cross-country pattern in the variance of current account (net trade) relative to total trade. Any economy is subject to various shocks all the time, most of which are not measured and recorded systematically. In the absence of an exhaustive catalogue of all the relevant shocks, we assume that the distribution of the shocks is the same for all economies over a long enough time period. Under this assumption, our theory implies that the more rigid the labor market, the more likely the effects of these shocks show up in the movement in the net trade (current account) rather than the movement in the total trade. In other words, a lower flexibility in the labor market may be associated with a greater variance of current account relative to total trade.

It is tempting to think that any impediment to a reallocation of capital and labor between sectors within an economy would slow down the current account adjustment or increase the variance of the current account relative to the total trade. In other words, our theory may be as much about how capital market rigidity could affect the pattern of current account adjustment. This, however, may not be case.

Consider credit market constraint (inability to borrow funds quickly from banks or capital market) faced by small and medium-sized firms. Suppose a favorable shock hits an economy that would make it profitable for firms in a particular sector to expand, the inability for the firms to borrow funds quickly due to the credit market constraint prevents a quick adjustment in the composition of goods trade. This may lead one to think that the economy would have to turn to current account to do the adjustment. However, current account adjustment is about borrowing and lending vis a vis the international capital market. If the small/medium firms cannot borrow funds quickly at home due to the credit market constraint, it is qually likely that they cannot borrow funds quickly from the international capital market. In this example, the imperfection in the credit market impedes both the access to the international capital market (i.e., the use of current account to accommodate a shock) and the reallocation of capital between sectors with the economy (i.e., the use of intra-temporal trade to adjust to the shock). Therefore, the linkage between credit market constraint and the pattern of current account adjustment is not clear cut.

4.1 Labor Market Rigidity and Trade Structure Flexibility

We first examine whether domestic labor market rigidity affects the churning of trade structure. Recent literature suggests that working with highly disaggregated sectoral data is important as most of the adjustment in capital-labor ration likely takes place within a finely defined sector rather than across sectors. For example, Schott (2004) documented that China and France (as examples of developing and developed countries) often appear to export the same set of products to the U.S. (according the US customs' classification of products). However, as their products appear to have different unit values, they are likely to be of different varieties. Since China and France have very different capital-to-labor ratios, this suggests that much of the difference in factor content is reflected in different specializations between

China and France within a common sector rather than across different sectors. The implication for us is that we need to work most disaggregated data possible.Had we had a satisfactory way to compute the churning of capital/labor ratio in exports and imports, we would have preferred to do that. As the next best thing, we compute the degree of churning for exports and imports (for any reason) country by country, using most disaggregated data available on exports and imports from the United Nations' Comtrade database at the HS 6 digit level[4].

To be precise, Let $s_X(j,h,t)$ = share of product h in country j's exports in year t, and $s_M(j,h,t)$ = share of product h in country j's imports in year t. Then the Trade Structure Churning Index for country j, or $Churning(j)$ for short, is defined by

$$Churning(j) = \frac{1}{T}\sum_{t=1}^{T}\sum_{h}[|s_X(j,h,t) - s_X(j,h,t-2)| + |s_M(j,h,t) - s_M(j,h,t-2)|]$$

where t = 1996, 1998, 2000, 2002, and 2004, and $T = 5$. The churning index is bounded between zero (no change in trade structure) and 2 (maximum possible change). The value of the trade structure churning index is reported in Column 3 of Table 1. Since agriculture, dairy farming, and fishery activities (agriculture for short) are generally difficult to switch in and out of, we have also computed a churning index excluding these activities and reported it in Column 4 of Table 1.

The index for labor market rigidities comes from the World Bank Investment Climate Assessment (ICA) based on an enterprise survey conducted by the World Bank in 2002. Specifically, it is the proportion of managers/survey respondents in a country who report labor regulation as a major business constraint (out of 18 categories listed on the questionnaire, including quality of infrastructure, macroeconomic

[4] It would have been useful to also examine churning of the output structure across countries. Unfortunately, the most disaggregated data set on sectoral output, the UNIDO database, has less than 100 sectors. This level of disaggregation is far below that of the trade data we are using here (which has over 5000 sectors at HS 6-digit).

instability, tax rate, tax administration, corruption, and crime). (Each respondent can report multiple categories as major constraints.) While one can also code the labor market regulation on the book, the strength of enforcement varies widely across countries. A strong law that is not well enforced is not as binding for firms as a weaker regulation that is strictly enforced. Since survey responses presumably take enforcement into account, the ICA index can be regarded as a de facto measure of labor market rigidity. In any case, the labor market rigidity index is presented in Column 5 of Table 1.

A scatter plot of the trade structure churning index (for all sectors) against the labor market rigidity index is reported in Figure 4. A negative association between the two is evident: countries with a more rigid labor market are more likely to have a low churning of their trade structures. With a t-statistics of -1.75, the slope coefficient is statistically different from zero at the 10% level. Brazil is an apparent outlier on the lower right part of the graph. If one removes Brazil, the new slope coefficient is still negative; but with a t-statistics of -1.60, it is only different from zero at the 15% level. If we remove agriculture, dairy, and fishery activities from the computation of the trade churning index, the new scatter plot is presented in Figure 5. The negative slope coefficient is more significant (at the 1% level with a t-statistic at -2.11) than Figure 4. After removing Brazil, the slope coefficient is still negative and significant at the 10% level (with a t-statistic at -1.94). To summarize, the data suggest that domestic labor market rigidity affects the speed of turnover of an economy's trade structure.

This result is after all not surprising: one would think that impediments to labor reallocation should necessarily slow down the adjustment in the trade structure. In that sense, Figures 4 and 5 can also be read as a confirmation that the measure of labor market rigidity captures useful information about the actual operation of the labor markets in these economies.

4.2 Labor Market Rigidity and Current Account Convergence Speed

We now turn to the second piece of empirical evidence. Exploiting an insight from the trade literature, one may regard a specific-factor model as describing the very short run of an economy, and a Hechscher-Ohlin setup with a completely flexible labor market as representing the very long run. In this context, one may consider the index of labor market rigidity as representing the length of the time it takes for a given economy to make the transition from the short run to the long run. Our theory predicts that the speed of convergence of the current account (scaled by GDP) from the short to the long run equilibrium increases with the flexibility of domestic labor market.

Before we present our empirical results, we first make a note of the existing empirical literature in the open-economy macroeconomics that examines the mean reversion property or estimates the speed of convergence of the current account towards long-run equilibrium (Milesi Ferretti-Razin, 1988; Freund, 2000; Freund and Warnock, 2005; and Clarida, Goretti, and Taylor, 2005). These estimations are often done for a single or a small number of developed countries and tend to be done without a theoretical microfoundation. Our theory can be regarded as a possible microfoundation for such estimations.

Our own empirical work follows a two-step procedure. In step one, for every country in the sample, we estimate a speed of convergence of current account to GDP ratio towards the steady state. This estimation utilizes the time series information country by country. In step two, we relate the speed of convergence to a country's degree of labor market rigidity, or the level of difficulties in firing or hiring workers. This steps is done for a cross section of countries. We explain the two steps in turn.

4.2.1 Estimating the Speed of Convergence for Current Account

Let $x(j,t)$ be the ratio of country j's ratio of current account to GDP in time t, or, $x(j,t) = ca(j,t)/gdp(j,t)$. Using Δ to denote first difference of a variable, we estimate

$$\Delta x(j,t) = \alpha(j) + \beta(j)x(j,t-1) + e(j,t) \tag{30}$$

for the period 1980-2005. Under the null hypothesis that the current account as a share of GDP does not converge, $\beta(j) = 0$. Under the alternative hypothesis that the ratio of current account to GDP converges to a long-run steady state, $\beta(j)$ is negative (and smaller than one in absolute value). The greater is $\beta(j)$ in absolute value, the faster is the speed of convergence. Note that this specification does not impose the constraint that the long-run value of the current account-to-GDP ratio should be zero. The country-specific long-run value in this specification is given by $-\alpha(j)/\beta(j)$. The idea that different countries may have different long-run values is consistent with Kraay and Venture (2000).

Our theory suggests that large economies' current accounts could behave systematically differently from smaller ones as foreign labor market flexibility also affects them. In the empirical tests, we exclude large economies, defined as those whose GDP accounts for more than 5% of world GDP. Consequently, the United States, Japan and Germany are excluded from the sample.

The estimation is done at both quarterly and annual frequencies. Data on current account and GDP come from the IMF's *International Financial Statistics* database. Potential serial correlations in the error term is mopped up by higher orders of the lags of the dependent variable (We will later consider a non-linear specification that allows for faster convergence when the current account is sufficiently far away from its long-run equilibrium level).

4.2.2 Relating the Adjustment Speed of Current Account to Labor Market Rigidity

Let $R(j)$ be an index of country j's rigidity of labor market, or a measure of the difficulty in firing or hiring workers. We relate a country's speed of current account adjustment to its labor market rigidity as follows:

$$\beta(j) = c + \gamma R(j) + u(j) \tag{31}$$

Under the null hypothesis that current account adjustment is not related to labor market rigidity, $\gamma = 0$. Under the alternative hypothesis that a more rigid labor market leads to a slower adjustment in current account, $\gamma > 0$ (recall that $\beta(j)$s are non-positive).

We now turn to the basic results from estimating Equation (31). As a first step, we estimate the speed of current account convergence country by country using quarterly data on the ratio of current account-to-GDP. There are 30 countries for which we simultaneously have quarterly CA data and a measure of labor market rigidity. These regression results are not reported to save space. As a second step, we implement the simplest possible bi-variate linear regression exploring any linkage between a country's speed of convergence for its current account and its labor market rigidity. The result is reported in Column 1 of Table 2. The slope coefficient is 1.06 and statistically significant. This is consistent with the notion that the current account convergence is systematically slower in countries with more rigid labor markets.

To see if this result is driven by any outlier, Figure 6 plots the estimates of $\beta(j)$ (speed of current account convergence) against $R(j)$ (labor market rigidity). The figure suggests a robustly positive relationship that is unlikely to be driven by one or two outliers.

The convergence speed for current account could be affected by factors other than labor market rigidity. Unfortunately, the literature does not provide much guidance on this as the empirical estimation on current account convergence tends to use only univariate time series. Since a key benefit of a flexible exchange rate regime is supposed to provide a country with a better insulation from external shocks, one might think that exchange rate regime matters for the speed of adjustment. It is well recognized that a country's self-declared (de jure) exchange rate regime does not often describe its actual behavior well (Frankel and Wei, 1994). We therefore add a de facto exchange rate regime classification a la Reinhart and Rogoff (2004). Specifically, a country in a given time period is classified into one of six regimes: a peg to a foreign currency, a crawling peg, a managed float, a float, free falling, and dual exchange rates. Since our regression is a cross-section, we assign an exchange rate regime classification to a country if it spends the most time on that regime during the sample period. The regression result is reported in Column 2 of Table 2. It turns out that the exchange rate regime designations are not statistically significant. The coefficient on labor market rigidity is basically unchanged (with a point estimate of 1.17 and still being statistically significant).

One might think that the level of economic development (or quality of public institutions) can also affect the speed of adjustment. So we also include per capita GDP (in logarithm) as a control variable. The result is reported in Column 3. It turns out the level of development does not play a significant role in the current account adjustment either.

We have tried other variations: merging various flexible exchange rate regimes into one, using an alternative measure of de facto exchange rate classification a la Levy-Yeyati and Sturzenegger (2002). These results are reported in the last four columns of Table 2. In all these cases, the coefficient on labor market rigidity remains positive and statistically significant at the 10% level. This suggests that the pattern that a more rigid labor is associated with a slower current account adjustment is robust.

Because annual data on current account/GDP ratio have less missing observations than quarterly data, one could work with a larger set of countries. Table 3 reports a set of regressions that relate the current account adjustment parameters estimated using annual data with labor market rigidity. The same pattern emerges: a more rigid labor market is associated systematically with a slower speed of current account adjustment. Now, however, the coefficient on per capita GDP is significant as well: the current account adjusts faster in poorer countries on average. The coefficients on the exchange rate regime classifiers are still insignificant, though the negative sign on various flexible regime dummies is consistent with the notion that current account adjusts faster in countries with a flexible exchange rate regime.

4.2.3 Current Account Adjustment Speeds Estimated from a Non-linear TAR Model

As Freund and Warnock (2005) and Clarida, Goretti, and Taylor (2005) suggest, the speed of current account is likely to be non-linear, faster for larger initial deviations from the long-run equilibrium. We now estimate the speed of current account adjustment by a threshold autoregressive (or TAR) model:

The TAR model allows the CA/GDP ratio to follow a unit-root process (i.e., no convergence) if its value stays within a certain range but reverts to its long-run equilibrium when the CA/GDP ratio exceeds some threshold values. To be more specific, the CA/GDP ratio in the TAR model is assumed to come from the following data generating process,

$$\begin{aligned} \Delta x(j,t) &= \alpha_1(j) + \beta(j)x(j,t-1) + e(j,t) \text{ if } |x(j,t-1)| > \phi(j) \\ &= \alpha_2(j) + e(j,t) \qquad\qquad \text{otherwise} \end{aligned} \tag{32}$$

where $\alpha_1(j)$, $\alpha_2(j)$, $\beta(j)$, and $\phi(j)$ are parameters to be estimated (for every country j in the sample). In practice, the estimation is done in sequence. The value of $\phi(j)$ is determined by a grid search. As O'Connell and Wei (2002) note, if transaction costs or other factors create a zone of non-converging current account, the TAR model provides a more powerful way to detect global stationarity than the linear AR specification – even if the true behavior of CA/GDP does not conform to the TAR specification.

Estimation of these models can be done via maximum likelihood or sequential conditional least squares. Franses and van Dijk (2000) demonstrate the equivalence of the two methods. Procedurally, we estimate the pooled model using the fixed effects panel estimator by performing a grid search over possible values of c. Starting with an initial value of c at 0.003, the search adds 0.003 in each successive round until c reaches the 75th fractile of the distribution of $|q^*|$.

After we obtain estimates of $\beta(j)$ from a TAR model country by country, we again connect them with the countries' level of labor market rigidity. The results are presented in Tables 4-5 (when the convergence speeds for CA/GDP are estimated with quarterly and annual data, respectively). The coefficients on the measure of labor market rigidity are positive in all specifications and statistically significant at the 10% level in 13 out of 14 cases. This again confirms the notion that more labor market rigidity is associated with slower convergence for CA/GDP to its long-run equilibrium. In Table 5, there is some evidence that the convergence is faster for countries with a flexible exchange rate regime, or lower level of income.

4.3 Standard Deviation of Current Account-to-Total Trade Ratio

Rather than looking at the speed of convergence, another way to gauge a country's reliance on current account to adjust to shocks is to look at the standard deviation of its CA/total trade ratio[5]. We compute this standard deviation, country by country,

[5] Bluedorn (2005) examines, for a set of small island economies in the Caribbean, current account responses to hurricanes. As we do not have measures of labor market rigidity for most of these economies, we do not adopt the idea here.

using the time series over the period 1980-2005. We then regress it on the measure of labor market rigidity, plus control variables. To be precise, let $std(j)$ = standard deviation of CA/total trade for country j, $R(j)$ be its labor market rigidity, and $Z(j)$ be a vector of other controls, then the specification is:

$$std(j) = c + \gamma R(j) + \eta Z(j) + u(j) \tag{33}$$

The proposition that a country with a more rigid labor market tends to rely more on its current account (relative to total trade) to adjust to shocks is interpreted as implying $\gamma > 0$. Since both real and nominal shocks could affect CA/total trade directly, we incorporate standard deviation of log CPI and standard deviation of log GDP (scaled by the mean of log GDP) as control variables. In addition, we allow exchange rate regimes to have a direct effect on the variability of the CA/total trade ratio.

The regression results are presented in the first four columns of Table 6. The estimates for γ are consistently positive and statistically significant at the 10 percent level. The estimates are consistent with the interpretation that labor market rigidity affects a country's relative reliance on its current account to do the adjustment to shocks. The variability of log CPI is also positively related to the variability of current account (unsurprisingly). A floating exchange rate regime also tends to be associated with more current account variability. Perhaps, surprisingly, GDP variability is not positively associated with current account variability.

A scatter plot of $std(j)$ against $R(j)$ in Figure 7 suggests that Brazil and Nicaragua may be outliers. We exclude these two countries and re-do the regressions. The results are presented in the last four columns of Table 6. With this modification of the sample, the variability of the current account/GDP ratio is now positively associated with the variability of log GDP (but no longer with log CPI). Most important for us, the positive and statistically significant association between the variability of the CA/GDP ratio and labor market rigidity appears to be robust to excluding possible outliers.

Taking together the various pieces of evidence, the data strongly suggest that a country's current account adjustment is closely linked to its labor market flexibility in a way that is consistent with the model in this paper.

5 Conclusion

This paper proposes a theory of current account adjustment that places domestic labor market institutions at the front and center. In particular, an economy's adjustment to a shock generally involves a combination of intra-temporal channel (a change in the composition of goods trade) and intertemporal channel (a change in net capital flows). When labor is sector specific (which can be regarded as the short run), all adjustment takes place through capital flows (and the model behaves like the textbook version of an intertemporal approach). When labor is completely mobile within an economy, then any shock can be accommodated by a change in the output and trade composition with no change in the current account. A relatively more rigid labor regulation slows down the transition from the short run to the long run and therefore slows down the speed of convergence for the CA/total ratio.

Three pieces of evidence are presnted. First, a rigid labor market makes an economy less nimbler and more likely to experience a low churning of its trade structure. Second, a higher rigidity of the labor market reduces the speed of convergence of the current account. And third, a country with a rigid labor market is likely to exhibit a higher variance of current account to total trade. These patterns are consistent with the theory's predictions.

This paper represents a first attempt to explore how domestic labor market institutions can affect patterns of current account adjustment. Many topics in the standard intertemporal approach to current account, such as the role of a fiscal policy, non-tradable sector, and asymmetric information have not been explored in this paper. It would naturally be interesting to rethink each of these topics in our theoretic framework and to re-examine the data if appropriate. We leave these for future research.

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6 Appendix

In this appendix we prove Lemma 1 and Proposition 4.

Proof of Lemma 1:

Substituting (20) into (18) and (19) and differentiating these two equations with respect to λ, we obtain:

$$\left[p_1\frac{\partial^2 f_1(.)}{\partial H_1 \partial K_1} + p_2\frac{\partial^2 f_2(.)}{\partial H_2 \partial K_2}\right]\frac{\partial H_1}{\partial \lambda} = -\left[p_1\frac{\partial^2 f_1(.)}{\partial K_1^2} + p_2\frac{\partial^2 f_2(.)}{\partial K_2^2}\right]\frac{\partial K_1}{\partial \lambda} \tag{34}$$

$$\left[p_1\frac{\partial^2 f_1(.)}{\partial H_1^2} + \lambda p_2\frac{\partial^2 f_2(.)}{\partial H_2^2}\right]\frac{\partial H_1}{\partial \lambda} = p_2\frac{\partial f_2(.)}{\partial L_2} - \left[p_1\frac{\partial^2 f_1(.)}{\partial H_1 \partial K_1} + \lambda p_2\frac{\partial^2 f_2(.)}{\partial H_2 \partial K_2}\right]\frac{\partial K_1}{\partial \lambda} \tag{35}$$

The homogeneity of degree 1 implies

$$H_i\frac{\partial^2 f_i(.)}{\partial H_i \partial K_i} + K_i\frac{\partial^2 f_i(.)}{\partial K_i^2} = 0 \tag{36}$$

$$H_i\frac{\partial^2 f_i(.)}{\partial H_i^2} + K_i\frac{\partial^2 f_i(.)}{\partial H_i \partial K_i} = 0 \tag{37}$$

Substituting (36) and (37) into (34) and (35) and solving for $\frac{\partial K_1}{\partial \lambda}$, we then have

$$\frac{\partial K_1}{\partial \lambda}\left[\frac{\Phi}{p_1\frac{\partial^2 f_1(.)}{\partial H_1 \partial K_1} + p_2\frac{\partial^2 f_2(.)}{\partial H_2 \partial K_2}}\right] = p_2\frac{\partial f_2(.)}{\partial H_2} \tag{38}$$

where

$$\Phi = -p_1^2 \Delta_1 - \lambda p_2^2 \Delta_2 + \Delta_3$$

and

$$\Delta_i = \frac{\partial^2 f_i(.)}{\partial H_i^2} \frac{\partial^2 f_i(.)}{\partial K_i^2} - \left(\frac{\partial^2 f_i(.)}{\partial H_i \partial K_i} \right)^2 > 0 \text{ for } i = 1, 2$$

since $f_i(.)$ is concave, and

$$\Delta_3 = p_1 p_2 \frac{\partial^2 f_1(.)}{\partial H_1 \partial K_1} \frac{\partial^2 f_2(.)}{\partial H_2 \partial K_2} \left[\frac{K_2 H_1}{H_2 K_1} - 1 \right] \left[\frac{H_2 K_1}{K_2 H_1} - \lambda \right]$$

Using (21) to solve for factor demands, we have

$$\frac{K_i}{H_i} = \left(\frac{1 - \alpha_i}{\alpha_i} \right) \left(\frac{w_i}{r} \right) \tag{39}$$

$\frac{K_2}{H_2} > \frac{K_1}{H_1}$ and $\left(\frac{K_1}{H_1}\right) / \left(\frac{K_2}{H_2}\right) < \frac{w_1}{w_2} = \lambda$ since $\alpha_1 > \alpha_2$ and $w_1 = \lambda w_2$. Thus, $\Delta_3 < 0$, which implies that $\Phi < 0$. Using (38), we have $\frac{\partial K_1}{\partial \lambda} < 0$, and then (34) implies that $\frac{\partial H_1}{\partial \lambda} < 0$.

We now turn to the sign of $\frac{\partial r}{\partial \lambda}$. Rewrite equations (18) and (19) as

$$p_1 \frac{\partial f_1(1, K_1/H_1)}{\partial K_1} = p_2 \frac{\partial f_2(1, K_2/H_2)}{\partial K_2} \tag{40}$$

$$p_1 \frac{\partial f_1(1, K_1/H_1)}{\partial H_1} = \lambda p_2 \frac{\partial f_2(1, K_2/H_2)}{\partial H_2} \tag{41}$$

Differentiating these two equations with respect to λ and using (36) and (37), we obtain:

$$\frac{p_1 \partial^2 f_1(.)}{\partial K_1^2} \left[\frac{\lambda K_2}{H_2} - \frac{K_1}{H_1} \right] \frac{\partial \left(K_1/H_1 \right)}{\partial \lambda} = p_2 \frac{\partial f_2(.)}{\partial H_2}$$

which implies that $\frac{\partial (K_1/H_1)}{\partial \lambda} < 0$. Note that $r = p_1 \frac{\partial f_1(1, K_1/H_1)}{\partial K_1}$. So $\frac{\partial r}{\partial \lambda} > 0$.

Finally we prove $\frac{\partial r}{\partial K} < 0$. Suppose that labor does not move across two sectors when capital starts to flow out. Differentiating (18) with respect to K, we have:

$$\left(\frac{p_1 \partial^2 f_1(.)}{\partial K_1^2} + \frac{p_2 \partial^2 f_2(.)}{\partial K_2^2} \right) \frac{\partial K_1}{\partial K} = \frac{p_2 \partial^2 f_2(.)}{\partial K_2^2}$$

which implies that $\frac{\partial K_1}{\partial K} > 0$. As K declines, K_1 decreases and so that K_1/H_1 decreases since H_1 does not change when capital starts to flow out. Thus, $r = p_1 \frac{\partial f_1(1, K_1/H_1)}{\partial K_1}$ increases.

Now differentiating zero profit conditions $p_1 = (w_1/A)^{\alpha_1} r^{1-\alpha_1}$ and $p_2 = (w_2/A)^{\alpha_2} r^{1-\alpha_2}$, 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. Thus $w_1/w_2 > \lambda$ when capital flows out, which implies that labor in sector 1 will not flow to sector 2. That is, as capital flows out, labor does not move across sectors and r increases, which proves $\frac{\partial r}{\partial K} < 0$.

Proof of Proposition 4:

Rewrite equations (24) and (25) as

$$
\begin{aligned}
p_1 \frac{\partial f_1(1, K_1^*/H_1^*)}{\partial K_1^*} &= p_2 \frac{\partial f_2(1, K_2^*/H_2^*)}{\partial K_2^*} && (42) \\
\lambda^* p_1 \frac{\partial f_1(1, K_1^*/H_1^*)}{\partial H_1^*} &= p_2 \frac{\partial f_2(1, K_2^*/H_2^*)}{\partial H_2^*} && (43)
\end{aligned}
$$

Comparing $r = p_1 \frac{\partial f_1(1, K_1/H_1)}{\partial K_1}$ with $r^* = p_1 \frac{\partial f_1(1, K_1^*/H_1^*)}{\partial K_1^*}$ is equivalent to comparing K_1/H_1 with K_1^*/H_1^*. Let $\lambda = 1$ in (40) and (41). Solving for K_i/H_i, we have $K_1/H_1 = k_1(p_1, p_2, 1)$. Using (42) and (43), we solve for K_i^*/H_i^* and have $K_1^*/H_1^* = k_1(p_1, p_2, \lambda^*)$. Note that the function forms of K_1/H_1 and K_1^*/H_1^* are the same when $\lambda = 1$. So we have:

$$
\begin{aligned}
K_1/H_1 - K_1^*/H_1^* &= k_1(p_1, p_2, 1) - k_1(p_1, p_2, \lambda^*) \\
&= \frac{\partial k_1(p_1, p_2, \widetilde{\lambda})}{\partial \lambda} (1 - \lambda^*) && (44)
\end{aligned}
$$

where $\lambda^* < \widetilde{\lambda} < 1$. To determine $\frac{\partial k_1(p_1, p_2, \widetilde{\lambda})}{\partial \lambda}$, we create an artificial small foreign economy which takes world prices as given and has a labor market with rigidity $\widetilde{\lambda}$. Equilibrium conditions in the artificial economy are the same as (42) and (43) but replacing λ^* by $\widetilde{\lambda}$. Differentiating equilibrium conditions in the artificial economy with respect to $\widetilde{\lambda}$, we obtain:

$$
\frac{p_1 \partial^2 f_1(.)}{\partial K_1^{*2}} \left[\frac{\widetilde{\lambda} K_1^*}{H_1^*} - \frac{K_2^*}{H_2^*} \right] \frac{\partial \left(K_1^*/H_1^* \right)}{\partial \widetilde{\lambda}} = p_1 \frac{\partial f_1(.)}{\partial H_1^*} \tag{45}
$$

Using (39) and noting that $w_2^* = \widetilde{\lambda} w_1^*$ in the artificial economy, we have $\left(\frac{K_2^*}{H_2^*}\right) / \left(\frac{K_1^*}{H_1^*}\right) > \frac{w_2^*}{w_1^*} = \widetilde{\lambda}$. Therefore, $\frac{\partial k_1(p_1, p_2, \widetilde{\lambda})}{\partial \lambda} = \frac{\partial \left(K_1^*/H_1^* \right)}{\partial \widetilde{\lambda}} > 0$. Applying this result to (44), we have $K_1/H_1 > K_1^*/H_1^*$. Thus, $r < r^*$ and the capital flows from the home country to the foreign country at period t.

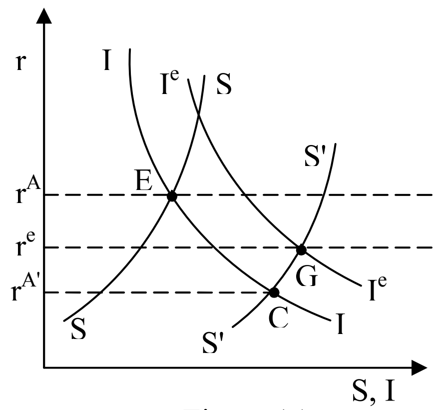

Figure 1A

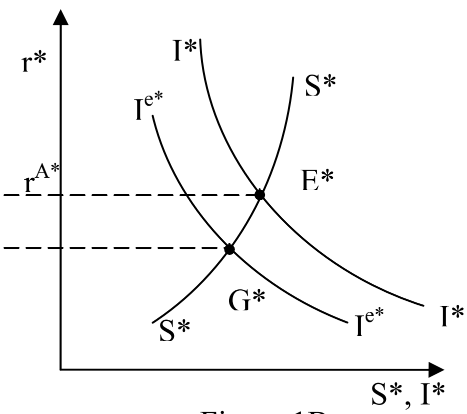

Figure 1B

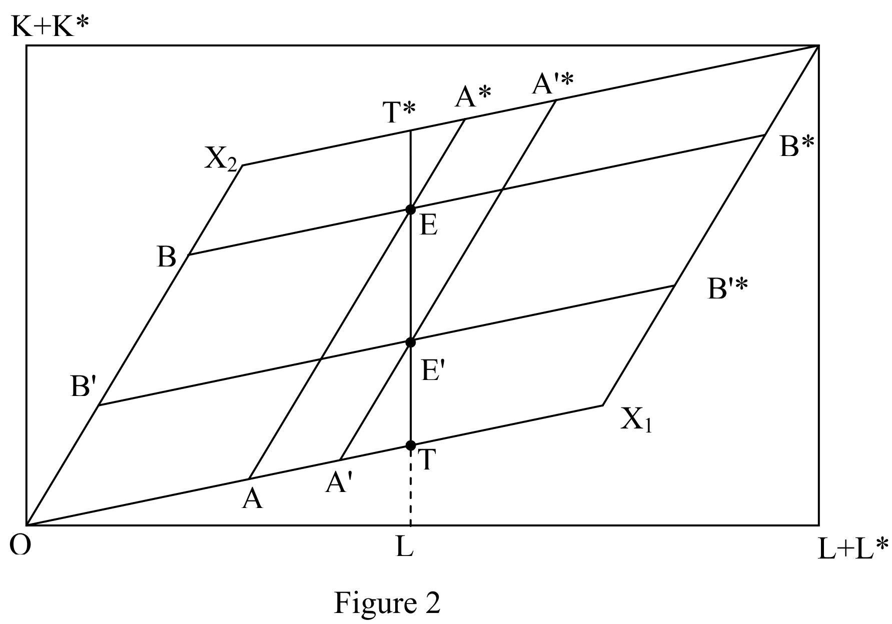

Figure 2

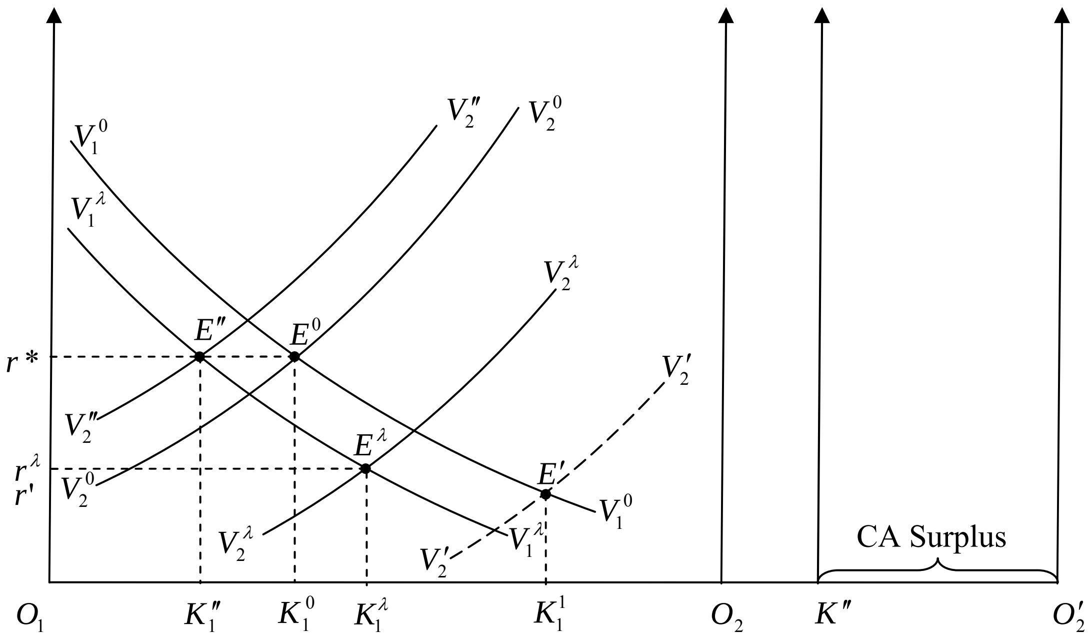

Figure 3

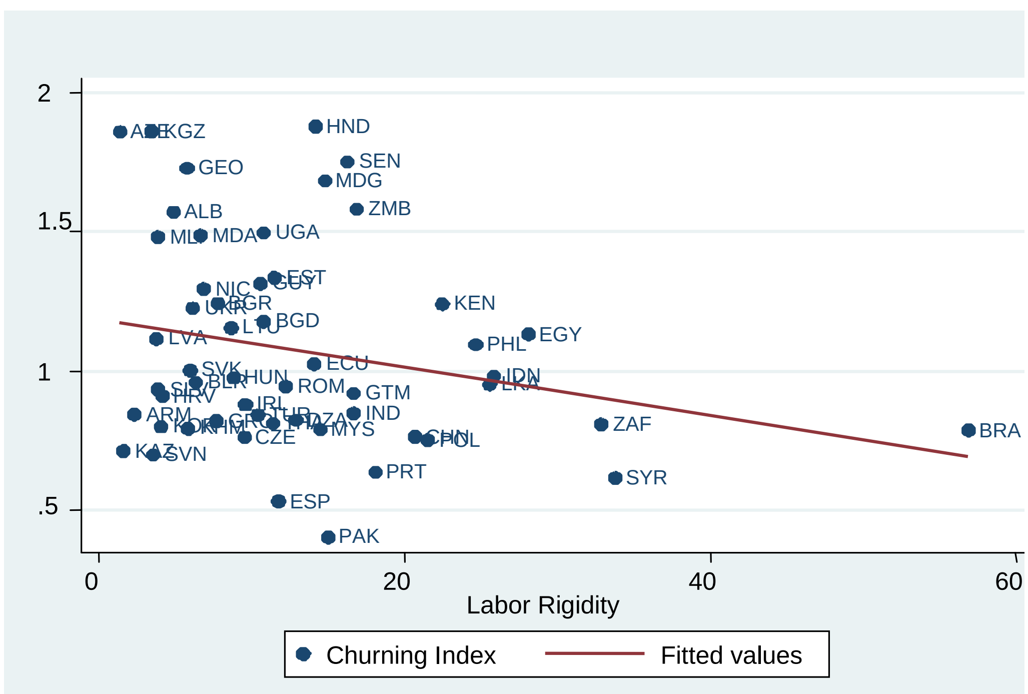

Figure 4: Trade Structure Churning vs Labor Market Rigidity, All Sectors

The slope coefficient (standard error) = -0.009 (0.005), t = -1.75

Excluding Brazil, the slope coefficient (standard error) = -0.010 (0.006), t = -1.60

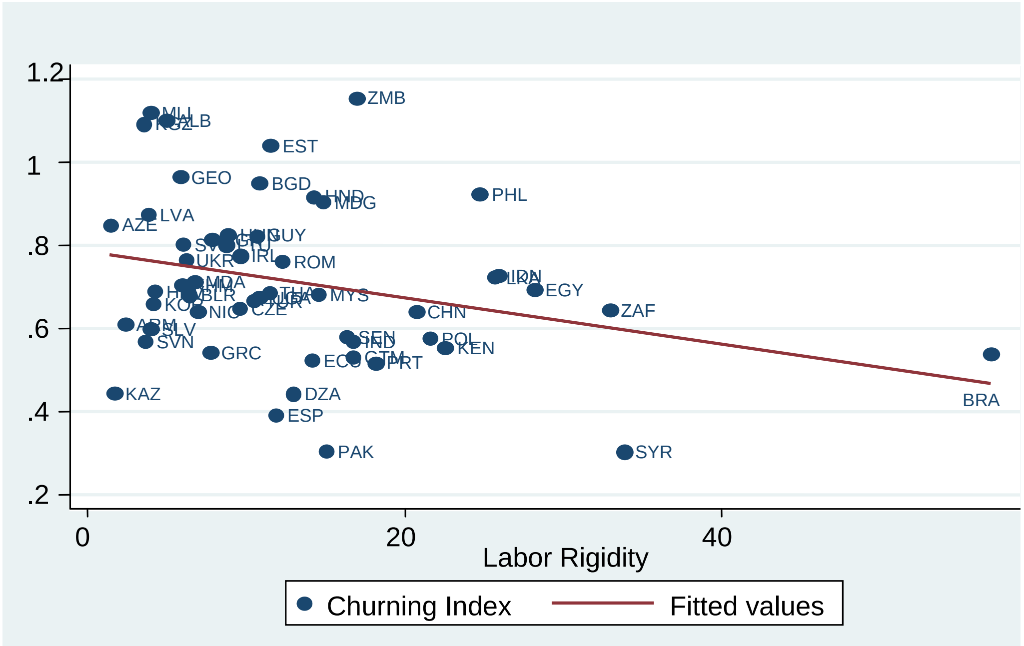

Figure 5: Trade Churning vs Labor Market Rigidity, Excluding Agriculture

The slope coefficient (standard error) = -0.0056 (0.0026), t = -2.11

Excluding Brazil, the slope coefficient (standard error) = -0.0065 (0.0034), t = -1.94

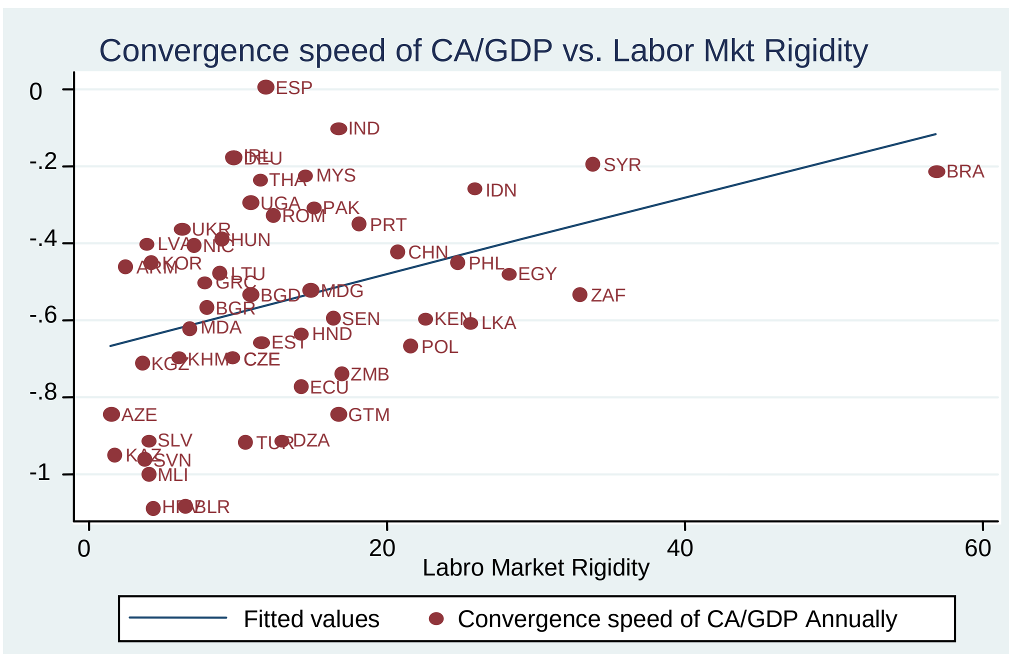

Figure 6: Convergence Speed of CA/GDP vs Labor Market Rigidity

(based on Column 1 of Table 3; Convergence speed estimated with annual data)

The slope coefficient (standard error) = 1.012 (0.350), t = 2.90

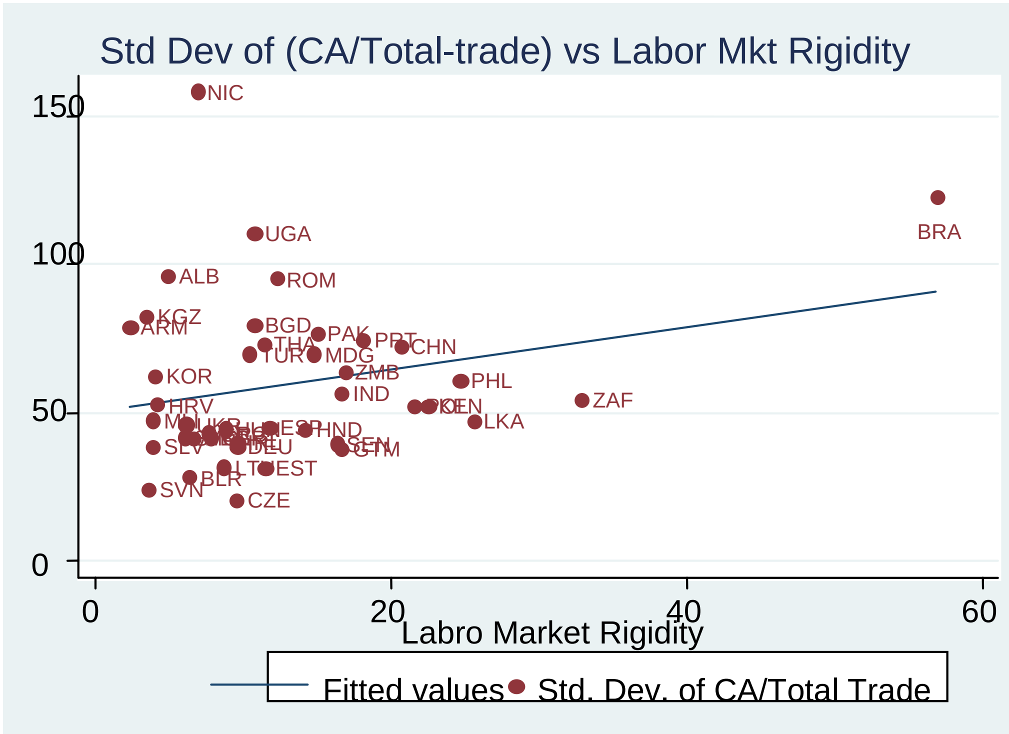

Figure 7: Standard Deviation of (CA/Total Trade) vs Labor Market Rigidity

The slope coefficient (standard error) = 13.71 (6.51), t = 2.11

Excluding Brazil and Nicaragua, the slope coefficient (standard error) = 14.52 (6.22), t = 2.33

Table 1: Labor Market Rigidity and Trade Structure Churning Index

Country Code 1	Country Name 2	Trade Structure Churning All sector 3	Trade Structure Churning Excluding Agriculture 4	Labor Market Rigidity 5
ALB	Albania	1.57	1.10	4.90
ARM	Armenia	0.84	0.61	2.35
AZE	Azerbaijan, Rep. of	1.86	0.85	1.40
BGD	Bangladesh	1.18	0.95	10.80
BGR	Bulgaria	1.24	0.81	7.80
BLR	Belarus	0.96	0.68	6.35
BRA	Brazil	0.79	0.54	56.90
CHN	China	0.76	0.64	20.70
CZE	Czech Republic	0.76	0.65	9.55
DZA	Algeria	0.82	0.44	12.90
ECU	Ecuador	1.02	0.52	14.10
EGY	Egypt	1.13	0.69	28.10
ESP	Spain	0.53	0.39	11.80
EST	Estonia	1.33	1.04	11.50
GEO	Georgia	1.73	0.96	5.80
GRC	Greece	0.82	0.54	7.70
GTM	Guatemala	0.92	0.53	16.70
GUY	Guyana	1.31	0.82	10.60
HND	Honduras	1.88	0.92	14.20
HRV	Croatia	0.91	0.69	4.20
HUN	Hungary	0.97	0.83	8.80
IDN	Indonesia	0.98	0.73	25.90
IND	India	0.85	0.57	16.70
IRL	Ireland	0.88	0.78	9.60
KAZ	Kazakhstan	0.71	0.44	1.65
KEN	Kenya	1.24	0.55	22.50
KGZ	Kyrgyz Republic	1.86	1.09	3.50
KHM	Cambodia	0.79	0.71	5.90
KOR	Korea	0.80	0.66	4.10
LKA	Sri Lanka	0.95	0.72	25.60
LTU	Lithuania	1.15	0.80	8.70
LVA	Latvia	1.12	0.88	3.80
MDA	Moldova	1.49	0.71	6.70
MDG	Madagascar	1.69	0.90	14.80
MLI	Mali	1.48	1.12	3.90
MYS	Malaysia	0.79	0.68	14.50
NIC	Nicaragua	1.29	0.64	6.90
PAK	Pakistan	0.40	0.30	15.00
PHL	Philippines	1.09	0.92	24.70
POL	Poland	0.75	0.58	21.55
PRT	Portugal	0.63	0.52	18.10

ROM	Romania	0.94	0.76	12.25
SEN	Senegal	1.75	0.58	16.30
SLV	El Salvador	0.93	0.60	3.90
SVK	Slovakia	1.00	0.80	6.00
SVN	Slovenia	0.70	0.57	3.60
SYR	Syrian Arab Republic	0.61	0.30	33.80
THA	Thailand	0.81	0.69	11.40
TUR	Turkey	0.84	0.67	10.45
UGA	Uganda	1.50	0.67	10.80
UKR	Ukraine	1.23	0.76	6.15
VNM	Vietnam	No data	No data	10.90
ZAF	South Africa	0.81	0.65	32.90
ZMB	Zambia	1.58	1.16	16.90

Sources:

1. Trade Structure Churning Indexes are computed by the authors using most disaggregated data available on exports and imports from the United Nations' Comtrade database at the HS 6 digit level. Let $s^X(j, k, t)$ = share of product k in country j's exports in year t, and $s^M(j, k, t)$ = share of product k in country j's imports in year t. Then the Trade Structure Churning Index for country j, or Churning(j) for short, is defined by

$$\text{Churning}(j) = 1/T \sum_t \sum_k [\,|s^X(j, k, t) - s^X(j, k, t-2)| + |s^M(j, k, t) - s^M(j, k, t-2)|\,]$$

Where t = 1996, 1998, 2000, 2002, and 2004, and T=5. The churning index is bounded between zero (no change in trade structure) and 2 (maximum possible change).

Column 3 is computed using data for all HS sectors. Column 4 is computed excluding HS Chapters 1-29 (i.e., excluding agriculture, dairy, fishery and related sectors).

2. Labor Market Rigidity (Column 5) refers to the fraction of managers who report labor regulations as either a major business constraint or a severe business constraint in a World Bank Investment Climate Assessment survey conducted in 2002. This should be regarded as a de facto measure of labor market rigidity.

Table 2: Labor Market Rigidity and Convergence Speed of CA/GDP
(with Convergence Speed Estimated with Quarterly Data, Controlling for Seanality)

	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q
Labor market rigidity	1.063	1.174	1.16	1.214	1.192	1.108	1.077
	(0.536)*	(0.615)*	(0.621)*	(0.562)*	(0.566)*	(0.575)*	(0.585)*
Exchange rate: crawling peg		-0.173	-0.217	-0.173	-0.219		
		(0.20)	(0.21)	(0.19)	(0.20)		
Exchange rate: managed float		-0.206	-0.212				
		(0.25)	(0.25)				
Exchange rate: float		(dropped)	(dropped)				
Exchange rate: free falling		-0.257	-0.239				
		(0.21)	(0.21)				
Exchange rate: dual market		-0.182	-0.177				
		(0.41)	(0.41)				
Exchange rate: managed float, float, free falling or dual market				-0.24	-0.229		
				(0.19)	(0.19)		
Exchange rate: float						-0.184	-0.153
						(0.14)	(0.15)
Exchange rate: intermediate						0.004	0.041
						(0.18)	(0.20)
Log GDP / capita [10,000US$]			0.109		0.112		0.071
			(0.14)		(0.13)		(0.13)
Constant	-0.57	-0.405	-0.437	-0.408	-0.441	-0.491	-0.54
	(0.090)*	(0.179)*	(0.185)*	(0.171)*	(0.177)*	(0.111)*	(0.144)*
Observations	30	30	30	30	30	30	30
R-squared	0.12	0.18	0.2	0.17	0.2	0.2	0.21

Standard errors in parentheses, * significant at 10%

The dependent variable is a country-specific regression coefficient for an AR process with lags that characterizes the speed of convergence of the current account to its long run equilibrium

The exchange rate regime classifications used in columns 2-3 and 4-5 are based on Reinhart and Rogoff (2004). In columns 4-5, their last three classifications are combined. The exchange rate classifications in column 6-7 are based on Levy-Yeyati and Sturzenegger (2002)

Table 3: Labor Market Rigidity and Convergence Speed of CA/GDP
(with Convergence Speed Estimated with Annual Data)

						b1A	b1A
Labor market rigidity	1.012 (0.350)*	1.228 (0.407)*	1.258 (0.396)*	1.133 (0.381)*	1.151 (0.371)*	0.969 (0.383)*	1.031 (0.367)*
Exchange rate: crawling peg		0.063 (0.11)	0.024 (0.11)	0.056 (0.11)	0.015 (0.11)		
Exchange rate: managed float		-0.048 (0.12)	-0.036 (0.12)				
Exchange rate: float		(dropped)	(dropped)				
Exchange rate: free falling		-0.115 (0.12)	-0.096 (0.12)				
Exchange rate: dual market		-0.235 (0.29)	-0.245 (0.28)				
Exchange rate: managed float, float, free falling or dual market				-0.061 (0.11)	-0.037 (0.11)		
Exchange rate: float						-0.028 (0.08)	-0.003 (0.08)
Exchange rate: intermediate						0.043 (0.12)	0.07 (0.11)
Log GDP / capita [10,000US$]			0.155 (0.086)*		0.162 (0.086)*		0.184 (0.081)*
Constant	-0.689 (0.059)*	-0.7 (0.092)*	-0.747 (0.093)*	-0.692 (0.096)*	-0.745 (0.097)*	-0.678 (0.070)*	-0.76 (0.076)*
Observations	49	47	47	47	47	47	47
R-squared	0.15	0.21	0.27	0.18	0.25	0.16	0.25

Standard errors in parentheses, * significant at 10%

The dependent variable is a country-specific regression coefficient for an AR process with lags that characterizes the speed of convergence of the current account to its long run equilibrium

The exchange rate regime classifications used in columns 2-3 and 4-5 are based on Reinhart and Rogoff (2004). In columns 4-5, their last three classifications are combined. The exchange rate classifications in column 6-7 are based on Levy-Yeyati and Sturzenegger (2002)

Table 4: Labor Market Rigidity and Current Account Convergence
(with CA/GDP convergence speed estimated from a TAR model, quarterly data)

	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q
Labor market rigidity	0.93 (0.464)*	1.008 (0.527)*	0.987 (0.518)*	1.038 (0.485)*	1.004 (0.474)*	1.04 (0.512)*	0.989 (0.514)*
Exchange rate: crawling peg		-0.183 (0.17)	-0.248 (0.17)	-0.183 (0.16)	-0.251 (0.17)		
Exchange rate: managed float		-0.126 (0.21)	-0.136 (0.21)				
Exchange rate: float		(dropped)	(dropped)				
Exchange rate: free falling		-0.248 (0.18)	-0.221 (0.18)				
Exchange rate: dual market		-0.198 (0.35)	-0.191 (0.34)				
Exchange rate: managed float, float, free falling or dual market				-0.212 (0.16)	-0.195 (0.16)		
Exchange rate: float						-0.109 (0.12)	-0.057 (0.13)
Exchange rate: intermediate						-0.074 (0.16)	-0.012 (0.17)
Log GDP / capita [10,000US$]			0.16 (0.12)		0.169 (0.11)		0.117 (0.11)
Constant	-0.6 (0.077)*	-0.439 (0.153)*	-0.487 (0.155)*	-0.441 (0.148)*	-0.491 (0.148)*	-0.548 (0.099)*	-0.629 (0.126)*
Observations	30	30	30	30	30	30	30
R-squared	0.13	0.2	0.26	0.18	0.25	0.15	0.19

Standard errors in parentheses, * significant at 10%

The dependent variable is a country-specific regression coefficient for a symmetric treshold AR process that characterizes the speed of convergence of the current account to its long run equilibrium

The exchange rate regime classifications used in columns 2-3 and 4-5 are based on Reinhart and Rogoff (2004). In columns 4-5, their last three classifications are combined. The exchange rate classifications in column 6-7 are based on Levy-Yeyati and Sturzenegger (2002)

Table 5: Labor Market Rigidity and Current Account Convergence:
(with CA/GDP convergence speed estimated with a TAR model, annual data)

	b1A	b1A	b1A	b1A	b1A	b1A	b1A
Labor market rigidity	0.96 (0.505)*	0.99 (0.565)*	1.049 (0.548)*	1.162 (0.554)*	1.204 (0.534)*	0.937 (0.590)	1.052 (0.556)*
Exchange rate: crawling peg		0.063 (0.16)	0.032 (0.16)	0.041 (0.18)	-0.004 (0.17)		
Exchange rate: managed float		0.013 (0.18)	0.05 (0.18)				
Exchange rate: float		-0.698 (0.354)*	-0.628 (0.345)*				
Exchange rate: free falling		-0.246 (0.18)	-0.189 (0.18)				
Exchange rate: dual market		-0.162 (0.38)	-0.16 (0.37)				
Exchange rate: managed float, float, free falling or dual market				-0.134 (0.17)	-0.078 (0.16)		
Exchange rate: float						-0.068 (0.12)	-0.048 (0.12)
Exchange rate: intermediate						0.033 (0.18)	0.053 (0.17)
Log GDP / capita [10,000US$]			0.283 (0.161)*		0.328 (0.170)*		0.365 (0.157)*
Constant	-0.794 (0.085)*	-0.758 (0.139)*	-0.865 (0.148)*	-0.77 (0.146)*	-0.892 (0.154)*	-0.776 (0.105)*	-0.915 (0.116)*
Observations	42	39	39	39	39	39	39
R-squared	0.08	0.29	0.35	0.14	0.22	0.1	0.22

Standard errors in parentheses, * significant at 10%

The dependent variable is a country-specific regression coefficient for a symmetric treshold AR process that characterizes the speed of convergence of the current account to its long run equilibrium

The exchange rate regime classifications used in columns 2-3 and 4-5 are based on Reinhart and Rogoff (2004). In columns 4-5, their last three classifications are combined. The exchange rate classifications in column 6-7 are based on Levy-Yeyati and Sturzenegger (2002)

Table 6: Labor Rigidity and Standard Deviation of (CA/Total Trade)

	all obs	all obs	all obs	all obs	excl. BRA & NIC	excl. BRA & NIC	excl. BRA & NIC	excl. BRA & NIC
Labor market rigidity	13.712	15.745	12.176	12.509	14.518	15.151	12.93	13.39
	(6.511)*	(7.403)*	(6.565)*	(6.795)*	(6.215)*	(7.170)*	(6.421)*	(6.312)*
Exchange rate: crawling peg		6.433	7.068			8.015	7.478	
		(9.83)	(10.01)			(9.29)	(9.51)	
Exchange rate: managed float		6.111				6.691		
		(10.98)				(10.48)		
Exchange rate: float		31.874				28.188		
		(17.144)*				(16.090)*		
Exchange rate: free falling		14.226				5.148		
		(16.35)				(15.92)		
Exchange rate: dual market		-0.282				2.106		
		(23.12)				(21.66)		
Exchange rate: managed float, float,			14.701				8.405	
free falling or dual market			(10.10)				(10.16)	
Exchange rate: float				1.746				-0.668
				(7.56)				(6.92)
Exchange rate: intermediate				1.653				13.815
				(11.54)				(11.48)
sd(lnCPI)	9.551	9.944	9.475	9.665	-4.038	-3.484	-3.271	-6.571
	(1.943)*	(2.083)*	(1.934)*	(2.097)*	(5.18)	(5.68)	(5.50)	(5.69)
sd(lnGDP) / mean(lnGDP)	-125.662	-181.012	-168.784	-125.979	218.668	222.032	178.874	289.532
	(84.62)	(134.70)	(91.116)*	(91.36)	(143.98)	(201.53)	(169.61)	(158.596)*
Constant	44.657	38.278	37.781	43.566	40.204	32.043	35.26	38.064
	(6.065)*	(8.855)*	(8.623)*	(6.792)*	(6.377)*	(8.898)*	(8.464)*	(6.901)*
Observations	42	41	41	41	40	39	39	39
R-squared	0.46	0.53	0.5	0.47	0.19	0.26	0.2	0.22

Standard errors in parentheses, * significant at 10%

The dependent variable is the country-specific standard deviation of Current Account / trade for the period from 1980 to 2005 (or all years for which data is available within this period)

The exchange rate regime classifications used in columns 2-3 and 6-7 are based on Reinhart and Rogoff (2004). In columns 3 and 7, their last three classifications are combined. The exchange rate classifications in column 4 and 8 are based on Levy-Yeyati and Sturzenegger (2002)

sd(lnCPI) is the standard deviation of the natural log of the Consumer Price Index and sd(lnGDP)/mean(lnGDP) is the standard deviation of the natural log of GDP divided by the mean of the natural log of GDP for each country over the period from 1980 to 2005.

Appendix 1: List of countries in regressions

	quarterly	annual	currency regime RR (2004)	currency regime LS (2002)	Labor rigidity
Albania		TAR	float	float	4.9
Algeria		AR, asTAR	peg	fixed	12.9
Armenia	AR, TAR, asTAR	AR	crawling peg	fixed	2.35
Azerbaijan, Rep. of		AR, asTAR	crawling peg	fixed	1.4
Bangladesh		AR, TAR, asTAR	crawling peg	float	10.8
Belarus	AR, TAR, asTAR	AR, TAR, asTAR	free falling	float	6.35
Brazil	AR, TAR, asTAR	AR, TAR, asTAR	dual market	float	56.9
Bulgaria	AR, TAR, asTAR	AR, TAR, asTAR	free falling	intermediate	7.8
Cambodia		AR, TAR, asTAR	free falling	float	5.9
China		AR, TAR, asTAR	peg	fixed	20.7
Croatia	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	float	4.2
Czech Republic	AR, TAR, asTAR	AR, TAR, asTAR	managed float	fixed	9.55
Ecuador	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	fixed	14.1
Egypt		AR, TAR, asTAR	managed float	fixed	28.1
El Salvador		AR, TAR, asTAR	managed float	fixed	3.9
Estonia	AR, TAR, assTAR	AR, TAR, asTAR			11.5
Georgia	AR, TAR, assTAR				5.8
Greece		AR, TAR, asTAR	crawling peg	intermediate	7.7
Guatemala	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	float	16.7
Guyana		TAR	crawling peg	fixed	10.6
Honduras		AR, TAR, asTAR	crawling peg	intermediate	14.2
Hungary	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	fixed	8.8
India		AR, asTAR	crawling peg	intermediate	16.7
Indonesia	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	float	25.9
Ireland	AR, TAR, asTAR	AR, asTAR	managed float	float	9.6
Kazakhstan	AR, TAR, asTAR	AR, TAR, asTAR	peg	intermediate	1.65
Kenya		AR, TAR, asTAR	managed float	float	22.5
Korea	AR, TAR, asTAR	AR, TAR, asTAR	managed float	float	4.1
Kyrgyz Republic	AR, TAR, asTAR	AR, TAR, asTAR	managed float	fixed	3.5
Latvia	AR, TAR, asTAR	AR, TAR, asTAR	peg	fixed	3.8
Lithuania	AR, TAR, asTAR	AR	peg	fixed	8.7
Madagascar		AR, TAR, asTAR	managed float	fixed	14.8
Malaysia	AR, TAR, asTAR	AR, TAR, asTAR	free falling	fixed	14.5
Mali		AR, TAR, asTAR	crawling peg	intermediate	3.9
Moldova		AR, asTAR	crawling peg	fixed	6.7
Nicaragua		AR, TAR, asTAR	free falling	float	6.9
Pakistan		AR, TAR, asTAR	free falling	float	15
Philippines	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	fixed	24.7
Poland	AR, TAR, asTAR	AR, TAR, asTAR	free falling	float	21.55
Portugal	AR, TAR, asTAR	AR, TAR, asTAR	free falling	fixed	18.1
Romania	AR, TAR, asTAR	AR, asTAR	peg	float	12.25
Senegal		AR, asTAR	managed float	fixed	16.3
Slovakia	AR, TAR, asTAR		free falling	float	6
Slovenia	AR, TAR, asTAR	AR, TAR, asTAR	managed float	float	3.6
South Africa	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	fixed	32.9
Spain	AR, TAR, asTAR	AR, TAR, asTAR	peg	fixed	11.8
Sri Lanka		AR, TAR, asTAR	peg	fixed	25.6
Syrian Arab Republic		AR	managed float	float	33.8
Thailand	AR, TAR, asTAR	AR, TAR, asTAR	peg	fixed	11.4
Turkey	AR, TAR, asTAR	AR, TAR, asTAR	crawling peg	intermediate	10.45
Uganda		AR, asTAR	crawling peg	fixed	10.8
Ukraine	AR, TAR, asTAR	AR, TAR, asTAR	managed float	float	6.15
Vietnam		TAR, asTAR			10.9
Zambia		AR, TAR	free falling	float	16.9

AR, TAR and asTAR indicate data availability for the regressions based on autoregressive process (AR), threshold autoregressive process (TAR) and asymmetric threshold autoregressive process (asTAR) Current Account convergence coefficients.

Currency regime reports the classification a country receives in Reinhart-Rogoff (RR 2004) and Yeyati-Sturzenegger (YS 2002) during most of the years between 1980 and 2005 for which their data is available. If two different classifications have been maintained for the same number of years, the more recent one is chosen.

Labor rigidity reports the share of managers ranking labor regulations as a major business constraint in a World Bank Enterprise Survey

Appendix 2: Description of exchange rate regime classifications Reinahrt and Rogoff (2004):

peg (excluded)	No separate legal tender Pre announced peg or currency board arrangement Pre announced horizontal band that is narrower than or equal to +/-2% De facto peg
crawling peg	Pre announced crawling peg Pre announced crawling band that is narrower than or equal to +/-2% De factor crawling peg De facto crawling band that is narrower than or equal to +/-2%
managed float	Pre announced crawling band that is wider than or equal to +/-2% De facto crawling band that is narrower than or equal to +/-5% Moving band that is narrower than or equal to +/-2% Managed floating
float	Freely floating
free falling	Freely falling
dual market	Dual market in which parallel market data is missing.

Reference: Reinhart, C. and K. Rogoff (2004): The modern history of exchange rate arrangements: A reinterpretation. NBER Working Paper 8963. http://www.nber.org/papers/w8963

Levy-Yeyati and Sturzenegger (2002):
floating
intermediate
fixed (excluded)

Reference: Levy-Yeyati, E. and Frederico Sturzenegger (2002): A de facto classification of exchange rate regimes. http://200.32.4.58/~ely/AppendixAER.pdf