Current Account Adjustment, Goods Trade, and Labor Market Rigidity: Theory and Some Evidence

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Abstract

This paper generalizes the textbook version of the intertemporal approach to current account by allowing for substitution between intertemporal trade (current account adjustment) and intra-temporal trade (goods trade). In general, in response to a shock, an economy adjusts through a combination of a change in the composition of goods trade (intra-temporal trade channel) and a change in the current account (intertemporal trade channel). The more rigid the labor market, the larger the size of current account adjustment relative to volume of goods trade, and slower the speed of adjustment of the current account towards its long-run equilibrium. Three pieces of empirical evidence are provided that are consistent with the theory.

Keywords: Current Account, Intertemporal Trade, Intra-temporal Trade, Labor Market Rigidity

JEL Classification Numbers: F3 and F4

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1 Introduction

One of the major advances in open-economy macroeconomics in the last thirty years is the intertemporal approach to current account, developed in seminal work by Sachs (1981, 1982) and Svesson and Razin (1983), codified in Obstfeld and Rogoff (1996). 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 predicts) (see, for example, Sheffrin and Woo, 1990; Otto, 1992; Ghosh, 1995; Obstfeld and Rogoff, 1996; and Hussein and de Melo, 1999). We label this as a "*level puzzle*." The Feldstein and Horioka puzzle (1980) that a country's saving and investment are highly correlated is another manifestation of the *level puzzle*. Tesar (1991), Backus and Smith (1993), Backus, Kehoe and Kydland (1992, 1994), and Glick and Rogoff (1995) show, from different angles, that the actual current account in the data is less variable than in the model.

In this paper, 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, by introducing two tradable sectors with heterogeneous capital intensities to the standard approach, we provide a possible explanation for the *level puzzle*. We show that any shock 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 to current account can be understood by appealing to the Heckscher-Ohlin theory of goods (intra-temporal) trade. Consider a shock that would have produced a desire to import capital in the classic intertemporal trade model with one-tradeable-sector. Instead of importing capital directly (i.e., adjusting the current account), a country can import capital indirectly by importing more of the capital-intensive product and at the same time exporting more of the labor-intensive product (i.e., adjusting the composition of the goods trade). In other words, the capital flow that would have taken place is substituted by a change in the composition of goods trade.

In general, if an economy's labor market is partially flexible, its response to a shock is 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). Intuitively, if labor is not completely mobile across sectors, then domestic output composition cannot change fully in response to a shock. So some of the adjustment must go through the current account. The relative importance of the current account channel depends on the degree of domestic labor market rigidity. Using a dynamic general equilibrium model, we show that as labor market becomes more rigid, the size of current account adjustment relative to intra-temporal trade volume will become larger and the speed of adjustment of the current account towards its steady state equilibrium will be slower.

Our approach is related to the IRBC literature that also addresses the *level puzzle*. Obstfeld (1986), Mendoza (1991) and Baxter and Crucini (1993) show that persistent productivity changes can produce a positive correlation between saving and investment in a dynamic general equilibrium model with perfect capital mobility but one tradeable sector. In our model, we can explain the *level puzzle* without persistent productivity changes. Backus, Kehoe, and Kydland (1992) show that trade frictions lower the variability of investment and net exports. Fernandez de Cordoba and Kehoe (2000) incorporate frictions in the domestic labor market that impede resource reallocation between the non-tradable and tradable sectors. In their model, the greater the labor market frictions, the smaller the current account change. In contrast, in our model, an increase in labor market frictions could augment rather than dampen the current account change. Corsetti, Dedola, and Leduc (2008) show that, with incomplete asset markets, strong wealth effects in response to shocks raise the demand for domestic goods above supply and therefore change the prediction for capital flows. Raffo (2008) argues that a class of preferences that embeds home production helps to explain countercyclical net exports. While the IRBC literature does not focus on the linkage between composition of goods trade and capital flow, our model is close to Cunat and Maffezzoli (2004) who introduce Heckscher-Ohlin trade features into a DSGE model, and is closest in spirit to Cole and Obstfeld (1991) who show that terms of trade responses alone may provide perfect insurance against output shocks so that gains from international portfolio diversification is small. In a recent paper, Jin (2008) discusses the effect of a change in industrial composition on the direction of capital flow, and argue that it can deliver capital flows from a labor abundant country to a capital abundant country.

This paper is also 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*).

The theory presented in this paper is related to an empirical literature in open-economy macroeconomics that estimates the speed of adjustment of the current account towards the long-run equilibrium (Milesi-Ferretti and Razin, 1998; Freund, 2000; Freund and Warnock, 2005; and Clarida, Goretti, and Taylor, 2005). This line of research typically finds that the current account has a tendency to regress back to its long-run equilibrium, with a speed of adjustment that is heterogenous across countries. The reason behind the mean reversion property and especially the cross-country heterogeneity in the adjustment speed is usually unexplained in the existing studies. Our theory provides a micro-foundation to understand these patterns.

The empirical part of the paper provides three types of results. First, we report evidence that an economy's frequency in the adjustment of the goods trade composition is linked to its labor market rigidity. This is a necessary but not sufficient condition for our story. Second, we examine a time-series implication of our theory: current account is mean-reverting, and the adjustment (to its long run equilibrium) is slower in a country with a more rigid labor market. We 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. Third, we report evidence that a country's current account (relative to total trade) is more variable if its labor market is more rigid. We interpret it as suggesting that economies with a more rigid labor market have a larger current account response to the same set of underlying shocks.

We organize the rest of the paper in the following way. Section 2 presents the basic model and proves our main theoretical result: with freely mobile labor across two tradable sectors, any shock to the economy is completely absorbed by intra-temporal trade without current account adjustment. Sector 3 calibrates the model. 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 Basic Model

The basis of the theoretical model presented here is the standard small open economy dynamic stochastic general equilibrium (DSGE) model. We depart from the canonical version of the model in two dimensions. First, we introduce two tradable sectors with different capital (labor) intensities. Second, we assume that the labor can not be costlessly and instantaneously reallocated between two sectors within the country.

2.1 Household

The economy is inhibited by a continuum of identical and infinitely lived household that can be aggregated into a representative household. The representative household's preferences over consumption and leisure flows are summarized by the following utility function

$$U = E_t \sum_{s=t}^{\infty} \theta_s U(C_s) \tag{1}$$

where C_s is the household's consumption on a final good at date s, and θ_t is the discount factor between period 0 and t given by

$$\theta_{t+1} = \beta(\tilde{C}_t)\theta_t,\ t \geq 0 \tag{2}$$

where $\theta_0 = 1$ and $\beta_{\tilde{c}} < 0$. We assume that the endogenous discount factor does not depend on the household's own consumption, but rather on the the average per capital consumption $\tilde{C}_s$, which individual household takes as given.[1] Meanwhile, the discount factor will also be affected by preference shock. The function form of $\beta(\tilde{C}_t)$ will be discussed in calibration. Households own both factors of production, capital K and a fixed labor supply $L = \bar{L}$, and sell their service in competitive spot market. To simplify the analysis, we consider a fixed labor supply model in text. In Appendix we show all our qualitative results remain when labor supply is endogenous.

In the economy, the households supply labor to both intermediate goods sectors, however, the labor can not be costlessly and instantaneously reallocated between two sectors. To model the labor market friction, we assume that the households are subject to quadratic labor adjustment costs for working in each sector. That is, if the households supply L_{it} to sector i in period t, they will bear the adjustment

[1] This preference specification was conceived by Uzawa (1968) and introduced in the small open economy literature by Mendoza (1991).

cost $\frac{\lambda}{2}(L_{it} - \bar{L}_i)^2$, where λ is a parameter that measure the labor market friction in sector i. As a result, the wages will be different across sectors. In addition, households are allowed to hold foreign asset B_t to smooth consumption. We also assume that trade in foreign bonds is subject to small portfolio adjustment costs. If the households hold an amount B_{t+1}, then these portfolio adjustment costs are $\frac{\psi}{2}(B_{t+1} - \bar{B})^2$ (denominated in the composite final good),[2] where $\bar{B}$ is an exogenous steady state level of net foreign asset.

Therefore, the budget constraint and capital accumulation equation faced by the households are give by

$$
\begin{aligned}
& C_t + I_t + \sum_{i=1}^{2} \frac{\lambda}{2}(L_{it} - \bar{L}_i)^2 + \frac{\psi}{2}(B_{t+1} - \bar{B})^2 + B_{t+1} \\
&= \sum_{i=1}^{2} w_{it} L_{it} + r_t K_t + (1 + r^*) B_t \qquad (3) \\
K_{t+1} &= K_t + I_t \qquad (4) \\
L_{1t} + L_{2t} &= L \qquad (5)
\end{aligned}
$$

where I_t is investment in period t, and w_{it} and r_t are wage rates in sector i and the domestic interest rate, while r^* being the world interest rate. For simplicity, we assume that there is no capital appreciation. We assume capital is freely mobile across sectors now and will show later that capital adjustment costs have similar effects on the economy as labor adjustment costs.

The first order conditions with respect to C_t, K_{t+1}, B_{t+1}, and L_{it} give intertemporal and intra-temporal optimization conditions

$$
\begin{aligned}
U_c'(C_t) &= \beta(\tilde{c}_t) E_t[U_c'(C_{t+1})(1 + r_{t+1})] \qquad (6) \\
U_c'(C_t)\left[1 + \psi(B_{t+1} - \bar{B})\right] &= \beta(\tilde{c}_t) E_t[U_c'(C_{t+1})(1 + r^*)] \qquad (7)
\end{aligned}
$$

[2] As in Schmitt-Grohé and Uribe (2003), these portfolio adjustment costs eliminate the unit root in the economy's net foreign assets.

$$\eta_t \left[w_{it} - \lambda(L_{it} - \bar{L}_i)\right] - \eta_{Lt} = 0, \ i = 1, 2 \tag{8}$$

where η_t and η_{Lt} are Lagrange multipliers for the budget constraint and labor supply constraint, respectively. Using (5) and (8), we have:

$$2\lambda(L_{1t} - \bar{L}_1) = w_{1t} - w_{2t}, \ 2\lambda(L_{2t} - \bar{L}_2) = w_{2t} - w_{1t} \tag{9}$$

2.2 Production

The production setting assumed in this paper is close in spirit to that in 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. $H_{it} = A_t L_{it}$ can be understood as *effective labor.* All production functions are assumed to be homogeneous of degree one. The final good is taken as numeraire and its price is normalized to 1.

The unit cost function for X_{it} is

$$\begin{aligned} \phi_i(\frac{w_{it}}{A_t}, r_t) &= \min\{w_{it}L_{it} + r_t K_{it} \mid f_i(A_t L_{it}, K_{it}) \geq 1\} \\ &= \min\{\left(\frac{w_{it}}{A_t}\right) H_{it} + r_t K_t \mid f_i(H_{it}, K_{it}) \geq 1\} \end{aligned} \tag{10}$$

Free entry ensures zero profit for the intermediate goods producers. Let p_i be the price of intermediate goods i. We assume that the country's endowment is always within the diversification cone so that both intermediate goods are produced. In period t zero profit condition implies that

$$p_{1t} = \phi_1(\frac{w_{1t}}{A_t}, r_t) \text{ and } p_{2t} = \phi_2(\frac{w_{1t}}{A_t}, r_t) \tag{11}$$

and

$$p_{it}X_{it} = w_t L_{it} + r_t K_{it}, \tag{12}$$

Let $\hat{X}_{it}$ be the usage of intermediate good i by the domestic final good producer. The profit maximization for the final good producer requires that

$$p_{1t} = \frac{\partial G(\hat{X}_{1t}, \hat{X}_{2t})}{\partial \hat{X}_{1t}} \text{ and } p_{2t} = \frac{\partial G(\hat{X}_{1t}, \hat{X}_{2t})}{\partial \hat{X}_{2t}}, \tag{13}$$

which implies

$$G(\hat{X}_{1t}, \hat{X}_{2t}) = p_{1t}\hat{X}_{1t} + p_{2t}\hat{X}_{2t} \tag{14}$$

This is the consequence of $G(.)$ being of homogenous of degree one and implies zero profit for the final good producer.

2.3 Equilibrium

In equilibrium, free trade in the intermediate good equalizes their product prices across countries in every period. That is,

$$p_{it} = p_i^*, \tag{15}$$

where p_i^* is taken as exogenously given. Following the assumptions in standard Hecksher-Ohlin model, we assume that production functions in all countries are the same. Therefore, in the foreign country we also have:

$$p_1^* = \phi_1(\frac{w^*}{A^*}, r^*) \text{ and } p_2^* = \phi_2(\frac{w^*}{A^*}, r^*) \tag{16}$$

In equilibrium, we have the following market clearing conditions in the home country

$$K_t = K_{1t} + K_{2t} \tag{17}$$

$$L_t = L_{1t} + L_{2t} \tag{18}$$

$$G(\hat{X}_{1t}, \hat{X}_{2t}) = C_t + I_t + \sum_{i=1}^{i=2} \frac{\lambda}{2}(L_{it} - \bar{L}_i)^2 + \frac{\psi_b}{2}(B_{t+1} - \bar{B})^2 \tag{19}$$

Equation (19) implies that the output of the final good covers not only consumption and investment, but also the labor adjustment costs and bond adjustment costs. The current account balance over period t is defined as $CA_t = B_{t+1} - B_t$; thus, using the zero profit condition for both intermediate goods and final goods (equations (12) and equation (14)) and final goods market clearing condition (equation (19)), we can rewrite the budget constraint as

$$CA_t = P_{1t}(X_{1t} - \hat{X}_{1t}) + P_{2t}(X_{2t} - \hat{X}_{2t}) + r^* B_t \tag{20}$$

We are now ready to discuss the substitutability between intertemporal trade and intra-temporal trade. When the labor market is frictionless but the bond adjustment is costly ($\lambda = 0, \psi > 0$), we want to demonstrate that the shocks to the economy are absorbed through changes in the composition of outputs and intra-temporal trade without any adjustment in current account. When the labor adjustment is costly but the bond market is frictionless ($\lambda > 0, \psi = 0$), we will show the opposite is true. That is stated as the following proposition.

Proposition 1 *If labor is freely mobile across sectors but the bond adjustment is costly, shocks to the economy are absorbed completely through the composition of outputs and intra-temporal trade without any adjustment in current account. If bond adjustment cost is zero but labor adjustment is costly, on the other hand, shocks to the economy are absorbed completely through the intertemporal trade without any adjustment in the composition of outputs.*

Proof. Proof: When $\lambda = 0$ and $\psi > 0$, equations (9) imply that $w_{1t} = w_{2t} = w_t$. Two zero profit conditions in (11) uniquely determine domestic factor prices, $\frac{w_t}{A_t}$ and r_t. As $p_{it} = p_i^*$, using equations (11) and (16), we must have $\frac{w_t}{A_t} = \frac{w^*}{A^*}$ and $r_t = r^*$ so that factor prices in two countries are equalized. Using equations (6) and (7), we then obtain that $B_{t+1} = \bar{B}$. In words, there is no adjustment in bond and all adjustments are carried in the composition of outputs.

When $\psi = 0$, equations (6) and (7) imply that $E_t[U_c'(C_{t+1})(r_{t+1} - r^*)] = 0$ for any distribution of shock. That is true only if $r_{t+1} = r^*$. Using equations (11) and (16), therefore, we must have $\frac{w_{1t}}{A_t} = \frac{w^*}{A^*} = \frac{w_{2t}}{A_t}$. Since $\lambda > 0$ and $w_{1t} = w_{2t}$, equations (9) imply that $L_{it} = \bar{L}_i$, which also imply that $K_{it} = \overline{K}_i$. Thus, no adjustment in the composition of outputs and all adjustments are carried by bond adjustments. ■

3 Quantitative Analysis

3.1 Calibration

We adopt the following standard function forms for preference and technology. The utility function is

$$U(C_t) = \frac{{C_t}^{1-\gamma}}{1-\gamma} \tag{21}$$

where γ is the inverse of the elasticity of inter-temporal substitution. The production function for the final good is

$$G(X_{1t}, X_{2t}) = \frac{1}{\omega^{\omega}(1-\omega)^{1-\omega}} X_{1t}^{\omega} X_{2t}^{1-\omega} \tag{22}$$

where ω is the share of intermediate goods X_1 in the final good production. The production function for intermediate good i is

$$f_i(A_{it}Lit, K_{it}) = \frac{1}{\alpha_i^{\alpha_i}(1-\alpha_i)^{1-\alpha_i}} K_{it}^{\alpha_i}(A_{it}L_{it})^{1-\alpha_i} \tag{23}$$

where a_i is the capital share in producing intermediate good i. We let $\alpha_1 < \alpha_2$ so that sector 1 is labor intensive. The endogenous time discount factor takes the following function form:

$$\beta(\tilde{C}_t) = \beta(\frac{\tilde{C}_t}{\bar{\tilde{C}}})^{-\psi} exp(v_t) \qquad (24)$$

where $\psi > 0$ and v_t is a preference shock. This form is a variant of Choi, Mark and Sul (2008).

Given the above preference and technology, we rewrite the equilibrium condition in the Technical Appendix. The model is calibrated in a standard way (see Backus, Kehoe, and Kydland (1992, 1994, 1995), and Kehoe and Peri (2002)). The parameters values are reported in Table 1. We set the inverse of the elasticity of intertemporal substitution $\gamma = 2$, the steady state discount factor $\beta = 0.99$, which implies that the annual word interest rate will be 4%. We set $a_1 = 0.3$ and $a_2 = 0.42$. Thus, sector 1 is labor intensive and sector 2 is capital intensive**.** We also assume an equal share of the intermediate good in the final good production, so $\omega = 0.5$. This means that the weighted average capital share is about 0.36. Following Schmitt-Grohé and Uribe (2003), the bond adjustment cost coefficient is set to 0.0007. The value of parameter that measures the labor marker friction, λ, will be chosen to match the elasticity of labor supply in sectoral level. For experiment, we will set $\lambda = 0, 4$, which implies different degree of labor market rigidities. The value of ψ in (24) does not affect the steady state, only has impact on the dynamic of the model. In our mode, We set $\psi = 0.1$, which is close to the value chosen in Choi, Mark and Sul (2008).

3.2 Basic Results

In this section, we report the impulse responses of macro variables to shocks to aggregate productivity shock A_t and time preference β_t , respectively. Our discussions focus on the dynamics of current account, foreign asset position and the trade of each intermediate good. To explain them, we also report the response of aggregate

Table 1: Parameter Values for the Small Open Economy

Symbol	Definition	Value
β	discount factor in steady state	0.99
γ	coefficient of risk aversion	2
α_1	capital share in intermediate good sector 1	0.3
α_2	capital share in intermediate good sector 2	0.42
ω	share of intermediate goods 1 in final good	0.5
ψ_b	coefficient of bond adjustment cost	0.0007
λ	the parameter of labor market friction t	0/4/20
ψ	the parameter of endogenous discount factor	0.1

consumption, capital and labor (both aggregate and sectoral level). We assume that economy in period 0 is in the steady state with zero foreign asset $B = 0$ and each intermediate sector is balanced, that is, $NX_i = X_i - \hat{X}_i = 0$. All shocks start to hit the economy in period 1. In the following figures, the dynamics of CA_t, NX_{it}, and B_t are reported in terms of their ratio to the steady state GDP, while the other variables are expressed in terms of percentage change comparing to the steady state.

3.2.1 Impulse response to A shock

Figures 1 and 2 report the responses of economy to a temporal productivity shock under flexible labor market ($\lambda = 0$) and rigid labor market ($\lambda = 4$), respectively. The horizontal axis represents time, while the vertical axis represents deviations of variables from the steady state. The log of A will increase by 1 percent in period 1, but will go back to steady state value $A = 1$ in period 2. Aggregate consumption jumps up in period 1 and then gradually declines to the steady state level. As capital starts to respond to the shock in period 2, the capital to effectively labor ratio, K/AL, drops in period 1 and then gradually increases to steady state level. The composition of outputs and the trade in intermediate goods follow the standard Heckscher-Ohlin theory, and are governed by the change in K/AL. The output X_1, capital usage K_1, labor usage L_1, and the net export NX_1 in the labor intensive sector 1 all jump up in the first period and then gradually decline to the steady state level, while the production patterns in capital intensive sector 2 are exactly opposite.

In the standard theory of small open economy, when the shock increases the income temporarily, consumption smooth will force the economy to run a current account surplus at the beginning. Consistent with Proposition 1, However, in Figure 1 we do not observe the adjustment of current account under flexible labor market at all. The adjustment is completely done through intermediate goods trade. In Figure 2, when labor market becomes rigid, the current account runs surplus, while the trade volume (NX_i) is much smaller than that in Figure 1. Now both intertemporal trade and intra-temporal trade respond to the shock.

In Figures 3 and 4, we consider a persistent productivity shock under flexible labor market ($\lambda = 0$) and rigid labor market ($\lambda = 4$), respectively. In period 1, the log of A will increase by 1 percent in period 1, after that $log(A_{t+1}) = 0.9log(A_t)$ where $t \geq 1$. From Figures 3 and 4, we can find that the responses of the economy are qualitatively the same as that in Figures 1 and 2, except that now the current account runs deficit in beginning periods under rigid labor market.

When labor market is rigid, patterns of current account responses to temporal shock and persistent shock differ. A temporal shock raises the income temporarily, so consumers save more and the economy runs a current account surplus. A persistent shock reduces the capital-labor ratio K/AL persistently, which drives capital inflow. That is not surprising and is consistent with the responses of small open economy in standard intertemporal trade models. When labor is freely mobile, however, it is surprising to see that in all cases current account does not respond to any shocks. This is dramatically different from the results in standard intertemporal trade models.

3.2.2 Impulse Responses to β Shocks

Consider an one period negative shock to time preference in period $t = 1$, say, the β falls down by 10 percent in period 1, but it will go back to the steady state value $\beta = 0.99$ in period 2. A decrease in β in period 1 means that the households have become less patient and would like to consume more in period 1 but less in the future periods.

In a standard small open economy, to finance more current consumption, the economy must borrow and run current account deficit. In our model, both external adjustment and internal adjustment can respond to the shocks. When labor is perfectly mobile across two sectors, again, the intertemproal trade can be perfectly substituted by intra-temporal trade. Figure 5 depicts how the economy responds to a temporal β shock under a flexible labor market ($\lambda = 0$). As expected, the consumption jumps in the first period and then goes back to the initial level. However, there is no current account adjustment and the foreign asset position is unchanged.

The changes in outputs of intermediate goods are governed by the capital-labor ratio, K/L. In response to the shock, the consumption increases in period 1, which leads K/L to drop below the steady state level in period 2 and then gradually increases to the steady state level after period 2. Correspondingly, sector 1 jumps up and then declines, while sector 2 does the opposite. Sector 1 exports and sector imports.

When the labor market becomes rigid ($\lambda = 4$), adjustments in both intertemporal trade and intra-temporal trade take place. Figure 6 shows that in response to a negative β shock, the economy responds in the same manner as in Figure 5 except that now the economy will also borrow and run current account deficit in the beginning and pay back the debt gradually in the future periods. In this case, the change in the intermediate goods trade is only a part of the adjustment; the remaining adjustment goes through the change in the current account.

In Figures 7 and 8 we plot the impulse responses of the economy to a persistent negative β shock under flexible labor market and rigid labor market, respectively. We assume that β falls down by 10 percent in period 1, but it will go back steady state value $\beta = 0.99$ gradually, following the process $\hat{\beta}_{t+1} = 0.4\hat{\beta}_t$ for period $t \geq 1$. The patterns of responses are similar to the case of temporal shock. Most important to us, when labor market is frictionless, there is no current account response at all.

3.2.3 CA adjustment and labor market friction

General speaking, in response to a shock, an economy 's adjustment involves a combination of intertemporal trade and intra-temporal trade. Proposition 1 states that in two extreme cases when labor market friction is zero relative to the bond market friction, all adjustments go through the intra-temporal trade channel, and when labor market friction is infinity relative to the bond market friction, all adjustments go through the intertemporal trade channel. The labor market friction tends to reduce or slow down the adjustment in changes in the composition of outputs and intra-temporal trade. If we hold the bond adjustment costs constant but vary labor adjustment costs from small to large, we would expect that there will be more intertemporal adjustment relative to intra-temporla adjustment.

In the following exercises, we want to show how the degree of labor market friction affect the substitution between intertemporal trade and intra-temporal trade. Given a shock, for each λ, we construct three indexes that can reflect the substitution between current account adjustment and intermediate goods trade and then show how these indexes change with λ.

We first calculate the average of the absolute value of trade volume $(NX_1 - NX_2)$ of first 8 periods for a given λ. Figures 9 and 10 reports the trade volume under A shock and β shock, respectively.[3] When λ becomes larger, the average trade volume become smaller. Second, we calculate the average of the absolute value of current

[3] In figures 9-14, we report the results under persistent shocks. However, the reported results also hold under.temporal shocks.

account of first 8 period and then obtain the ratio of average current account to average trade volume. We report the relation between the ratio and λ in Figures 11 and 12 under A shock and β shock, respectively. The figures clearly show that when the labor marker friction increases, relatively speaking, current account adjustment becomes larger. In other words, the economy will depends more on the intertemporal adjustment rather than intra-temporal adjustment. Third, we set a threshold for B_t. If the absolute value of B_t is smaller than that threshold, we say that the foreign asset position has converged to the steady state level. The relation between λ and the time that bond reaches the steady state level are reported in Figures 13 and 14. We find that as λ becomes larger, it takes a longer time for the foreign debt position to go back the steady state. That is, the speed of current account convergence is slower. In short, when the labor market becomes more rigid, then current account adjustment will become larger (in terms of size) and slower (in terms of the speed of convergence).

3.3 Robustness

3.3.1 Industrial Heterogeneity

The key departure of our model from the classical intertemporal trade model is to introduce two tradable sectors with different factor intensities. When the difference in factor intensities across two intermediate sectors decreases, we would expect that our model converges to the classical one sector intertemporal trade model in which all adjustments are carried by the current account.

Figures 15 and 16 report the experiments of changes in differences in factor intensity across two sectors, under persistent A and B shocks, respectively. We keep $\lambda = 4$ and hold the aggregate capital share $(\alpha_1 + \alpha_2)/2 = 0.36$. The results show that the larger the difference in capital intensity, the smaller the adjustment of current account will be, which confirms that the industrial heterogeneity in factor intensity is a key driver for our results.

3.3.2 Capital Adjustment Costs

We now add capital adjustment costs. Suppose the households supply K_{it} to sector i in period t. We assume that they will bear the adjustment cost $\frac{\lambda_K}{2}(K_{it}-\overline{K}_i)^2$, where λ_K is a parameter that measure the capital market friction in sector i. The budget constraint and capital accumulation equation now become:

$$\begin{aligned} & C_t + I_t + \sum_{i=1}^{2}\frac{\lambda}{2}(L_{it}-\bar{L}_i)^2 + \sum_{i=1}^{2}\frac{\lambda_K}{2}(K_{it}-\overline{K}_i)^2 + \frac{\psi}{2}(B_{t+1}-\bar{B})^2 + B_{t+1} \\ = & \sum_{i=1}^{2} w_{it}L_{it} + \sum_{i=1}^{2} r_{it}K_{it} + (1+r^*)B_t \\ K_{t+1} = & K_t + I_t,\ K_{it+1} = K_{it} + I_{it} \\ L_{1t} + L_{2t} = & L \end{aligned}$$

Similar to the analysis above, we derive the first order conditions with both labor and capital adjustment costs and then conduct calibrations. For simplicity, we assume that the labor adjustment cost is zero in the calibration. All results of capital adjustment costs are qualitatively similar to that of labor adjustment costs. In particular, as capital adjustment cost becomes larger, there will be more current account adjustments relative to the change in trade volume. The results are not reported to save the space, but are available upon the request.

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 frequency of adjustment in the composition of its goods trade? 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 in goods and services?

These three questions are inter-related. In our theory, flexibility of domestic labor market affects an economy's ability to change the composition of goods trade rather than its 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 flexibility 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.[4]

The second question examines an implication of our theory for the dynamics of the current account. According to our theory, the current account adjustment to a shock is slower if domestic labor market is less flexible. 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. This reasoning generates the predictions that current account is mean-reverting and that current account adjustment is slower if domestic labor market is less flexible. For the active empirical literature that estimates the mean reversion property of the current account (and finds cross country differences in the speed of current account convergence), our theory can be thought of as a micro-foundation.

The third question we examine is an implication of our theory for the cross-country pattern in the variance of current account (net trade) relative to total trade (exports plus imports). 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

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

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 rigidities could affect the pattern of current account adjustment. This, however, may not be the case. Consider credit market constraints (an 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 these firms to borrow funds quickly due to credit market constraints prevents a quick adjustment in the composition of goods trade. This may lead one to think that the economy would have to turn to the current account to do the adjustment. However, current account adjustment is about borrowing and lending vis a vis the international capital market. If small/medium-sized firms cannot borrow funds quickly at home due to the credit market constraints, it is equally likely that they cannot borrow funds quickly from the international capital market. In this example, imperfections in the credit market impede 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 within the economy (i.e., the use of intra-temporal trade to adjust to the shock). Therefore, the linkage between credit market constraints and the pattern of current account adjustment is ambiguous.

4.1 Labor Market Rigidity and Trade Structure Flexibility

We first examine whether domestic labor market rigidity affects the churning of trade structure (i.e., the average change in the composition of exports and imports over time). Recent empirical trade studies suggest that working with highly disaggregated sectoral data is important as most of the adjustment in capital-labor ratio 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 specialization between China and France within a common sector rather than across different sectors. The implication for us is that we need to work with the most disaggregated data possible. Absent a satisfactory way to compute the churning of capital/labor ratio in exports and imports, 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.[5]

To be precise, Let $s_X(j,h,t)$ = the share of product h in country j's exports in year t, and $s_M(j,h,t)$ = the 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 2. Since agriculture, dairy farming, and fishery activities (agriculture

[5] 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).

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 2.

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 2003.[6] 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 instability, tax rate, tax administration, corruption, and crime. Each respondent can report multiple categories as major constraints.) This measure of labor market rigidity is preferable to simply coding the labor market regulations on the book, since 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 2.

A scatter plot of the trade structure churning index (for all sectors) against the labor market rigidity index is reported in Figure 17. 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 18. The negative slope coefficient is more significant (at the 1% level with a t-statistic at -2.11) than Figure 17. After removing Brazil, the slope coefficient is still negative and significant at the 10% level (with a t-statistic at -1.94). To

[6] http://iresearch.worldbank.org/InvestmentClimate. The data were used in the World Banks' *World Development Report 2005*.

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 17 and 18 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. 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 then predicts that the speed of convergence of the current account (scaled by GDP) 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 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. 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

$$\Delta x(j,t) = \alpha(j) + \beta(j)x(j,t-1) + e(j,t) \tag{25}$$

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). We now turn to the second step of our empirical design, namely, relating the estimated speed of current account convergence to labor market rigidity.

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:

$$\beta(j) = c + \gamma R(j) + u(j) \tag{26}$$

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 (26). 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 current account convergence and its labor market rigidity. The result is reported in Column 1 of Table 3. 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.

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, and most empirical estimation on current account convergence uses 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 a majority of the time in that regime during the sample period. The regression result is reported in Column 2 of Table 3. 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).

In addition, one might think that the level of economic development (or the quality of public institutions) can 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 (2003). These results are reported in the last four columns of Table 3. 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.

The results so far use quarterly data. However, because annual data on current account/GDP ratio have fewer missing observations than quarterly data, we can work with a larger set of countries. Table 4 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 with a systematically 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. To check if this result is driven by any outlier, Figure 19 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.

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 adjustment is likely to be non-linear, with faster adjustment for larger initial deviations from the long-run equilibrium. To take this into account, 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,

$$\Delta x(j,t) = \alpha_1(j) + \beta(j)x(j,t-1) + e(j,t) \text{ if } |x(j,t-1)| > \phi(j)$$
$$= \alpha_2(j) + e(j,t) \quad \text{otherwise} \tag{27}$$

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 ϕ. Starting with an initial value of ϕ at 0.003, the search adds 0.003 in each successive round until ϕ reaches the 75th fractile of the distribution of $x(j,t-1)$.

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 5-6 (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 6, there is some evidence that the convergence is faster for countries with a flexible exchange rate regime, or lower level of income.

4.3 Volatility 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 the country's CA/total trade ratio. Under the assumption that the distribution of the underlying shocks is the same across countries, our theory predicts that an economy's current account becomes more volatile if its domestic labor market is more rigid.[7] In this subsection, we compute this standard deviation, country by country, 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:

$$std(j) = c + \gamma R(j) + \eta Z(j) + u(j) \tag{28}$$

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 include the 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 7. 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

[7] 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.

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 20 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 7. 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 front and center. In particular, an economy's adjustment to a shock generally involves a combination of an intratemporal channel (a change in the composition of goods trade) and an intertemporal channel (a change in net capital flows). When labor is sector specific (which can be regarded as the very short run), all adjustment for a small open economy 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, 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/GDP ratio.

Three pieces of empirical evidence are presented. First, a rigid labor market makes an economy less nimble 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 the substitution between intra-temporal trade adjustment and current account adjustment. Many topics in the standard intertemporal approach to current account, such as the role of 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.

6 Appendix

The representative households' preferences over consumption and leisure flows are summarized by the following utility function

$$U = \sum_{s=t}^{\infty} \beta_{s,t} U(C_s, 1 - L_s) \tag{29}$$

where $\beta_{s,t} = \prod_{v=t}^{s} \beta_v$ and β_v is the stochastic discount factor between periods $v-1$ and v, which represents a preference shock; C_s is the per-capital consumption at date s; L is the time share devoted to labor at date t. Households own both factors of production, capital K and labor L, and sell their service in competitive spot market.

In the economy, the households supply labor to both intermediate goods sectors, however, the labor can not be costlessly and instantaneously reallocated between two sectors. To model the labor market friction, we assume that the households are also subject to quadratic labor adjustment costs for working in each sector. That is, if the households supply L_{it} to sector i in period t, they will bear the adjustment cost $\frac{\lambda}{2}(L_{it} - \bar{L}_i)^2$, where λ is a parameter that measure the labor market friction and $\bar{L}_i$ is the steady state labor used in sector i. As a result, the wages will be different across sectors. In addition, households are allowed to hold foreign asset B_t to smooth consumption. We also assume that trade in foreign bonds is subject to small portfolio adjustment costs. If the households hold an amount B_{t+1}, then these portfolio adjustment costs are $\frac{\psi}{2}(B_{t+1} - \bar{B})^2$ (denominated in the composite final good), where $\bar{B}$ is an exogenous steady state level of net foreign debt.[8]

Therefore, the budget constraint and capital accumulation equation faced by the households are give by

$$C_t + I_t + \sum_{i=1}^{2} \frac{\lambda}{2}(L_{it} - \bar{L}_i)^2 + \frac{\psi}{2}(B_{t+1} - \bar{B})^2 + B_{t+1} = \sum_{i=1}^{2} w_{it} L_{it} + r_t K_t + (1 + r^*) B_t \quad (30)$$

$$K_{t+1} = K_t + I_t \quad (31)$$

where I_t is investment in period t, and w_{it} and r_t are wage rates in sector i and the domestic interest rate, while r^* being the world interest rate. Note that here we have set $P_t = 1$.

The first order conditions with respect to C_t, K_{t+1}, B_{t+1}, and L_{it} give intertemporal and intra-temporal optimization conditions

$$U_c'(C_t, 1 - L_t)\left[1 + \psi(B_{t+1} - \bar{B})\right] = \beta_{t+1}(1 + r^*) U_c'(C_{t+1}, 1 - L_{t+1}) \quad (32)$$

$$U_c'(C_t, 1 - L_t) = \beta_{t+1} U_c'(C_{t+1}, 1 - L_{t+1})(r_{t+1} + 1) \quad (33)$$

$$-\frac{U_L'(C_t, 1 - L_t)}{U_c'(C_t, 1 - L_t)} + \lambda(L_{it} - \bar{L}_i) = w_{it}, \; i = 1, 2 \quad (34)$$

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Figure 1: Impulse response to a temporal A shock without labor market friction

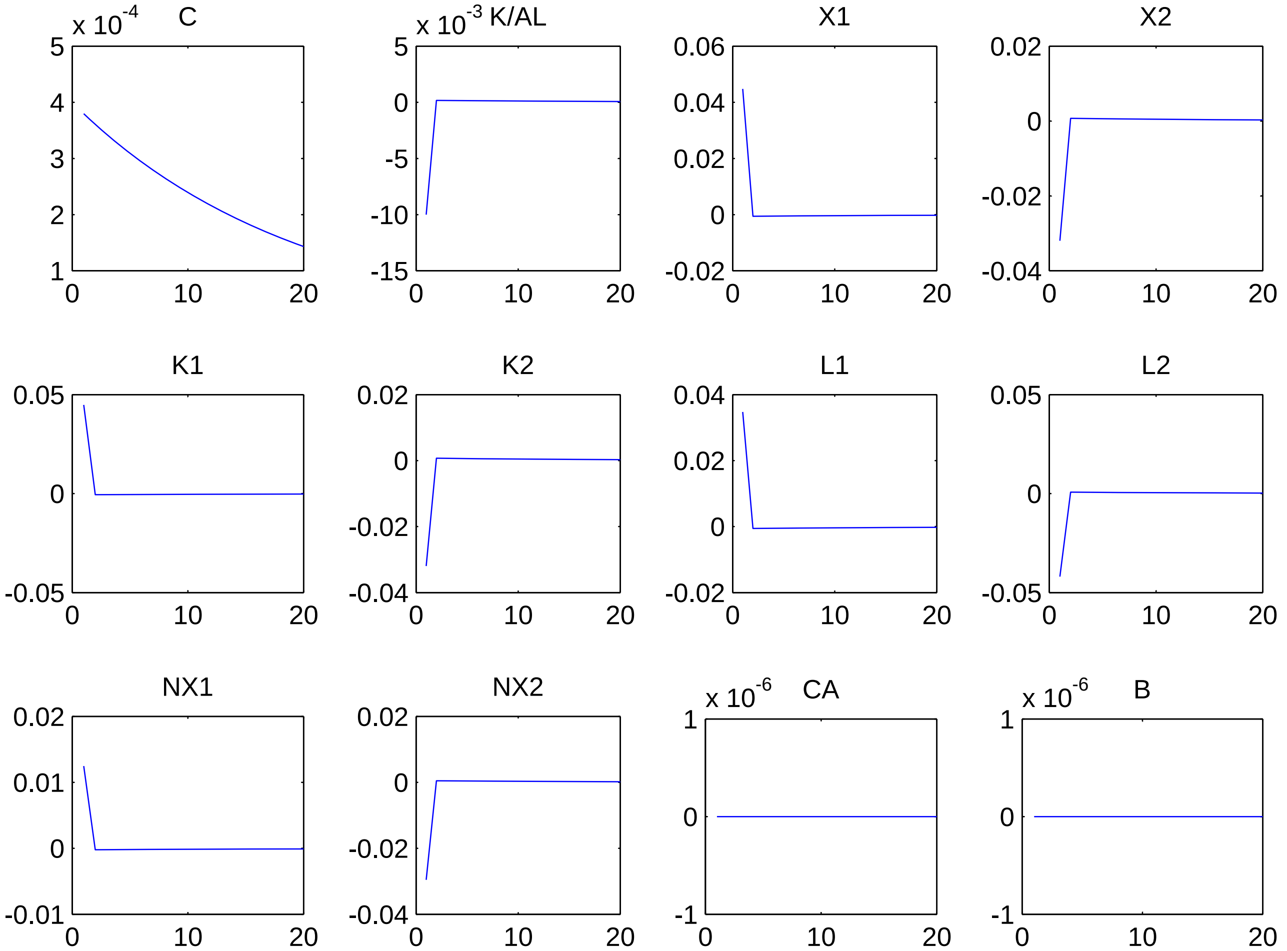


Figure 2: Impulse response to a temporal A shock with labor market friction

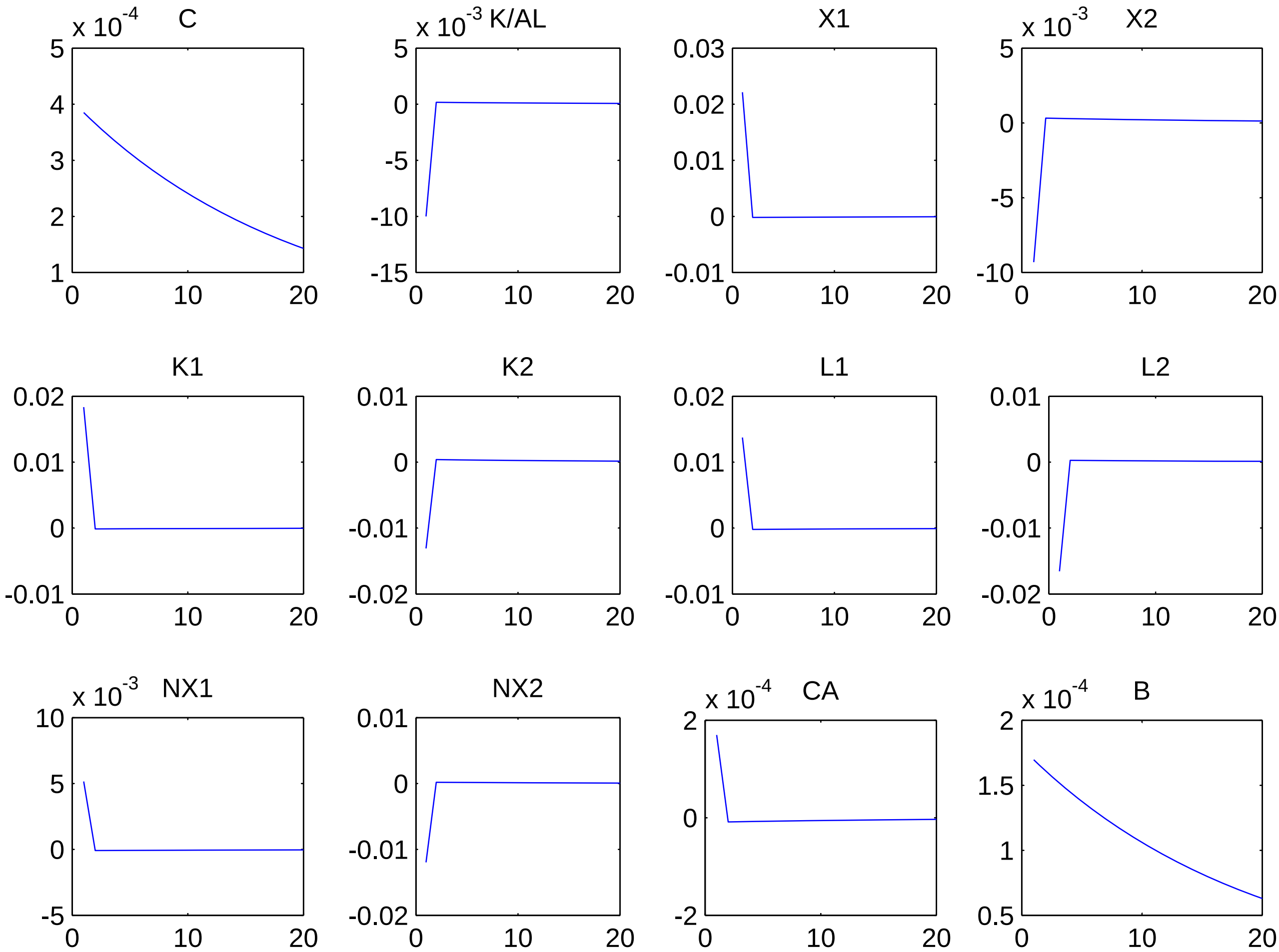


Figure 3: Impulse response to a persistent A shock without labor market friction

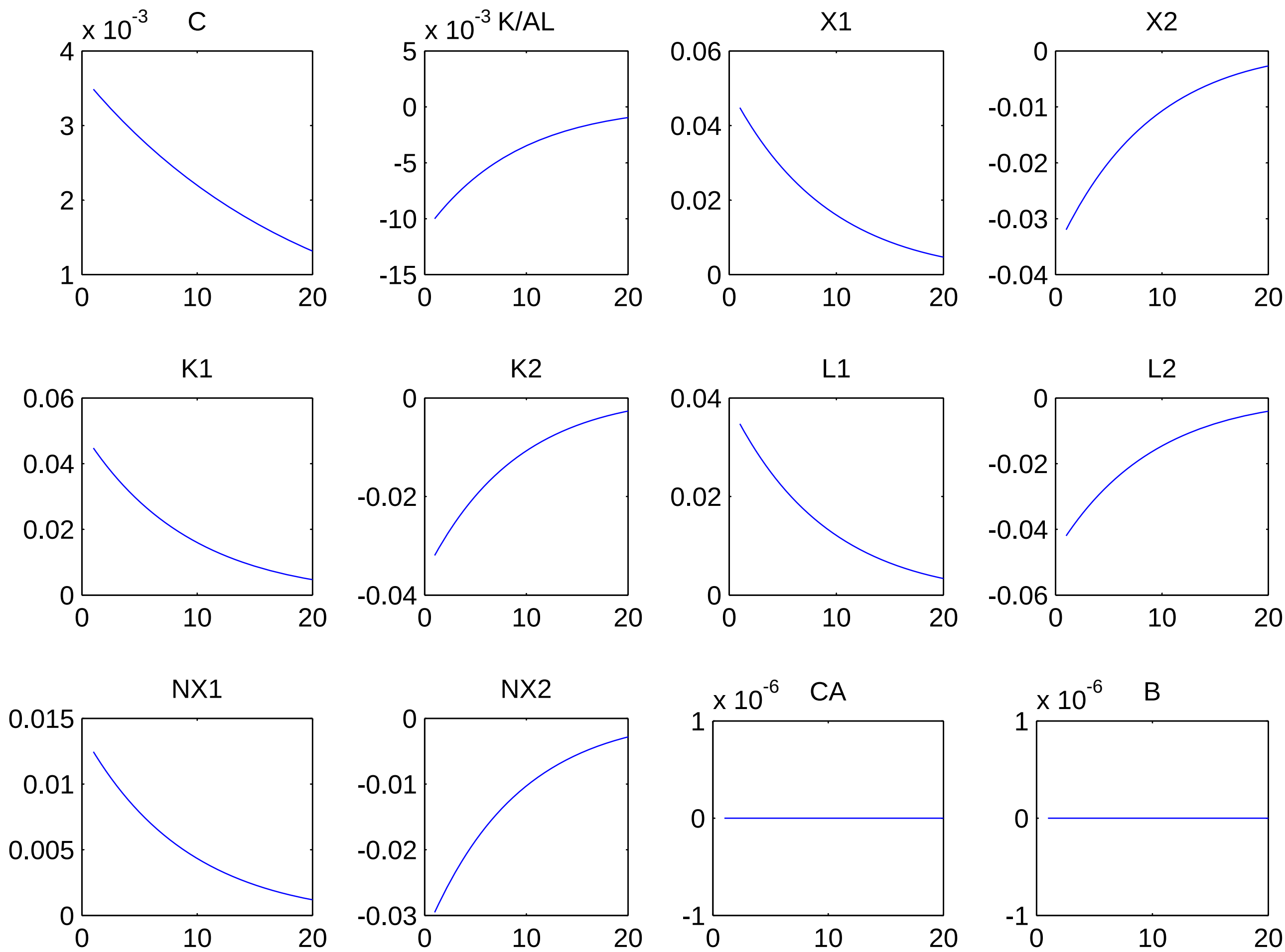


Figure 4: Impulse response to a persistent A shock with labor market friction

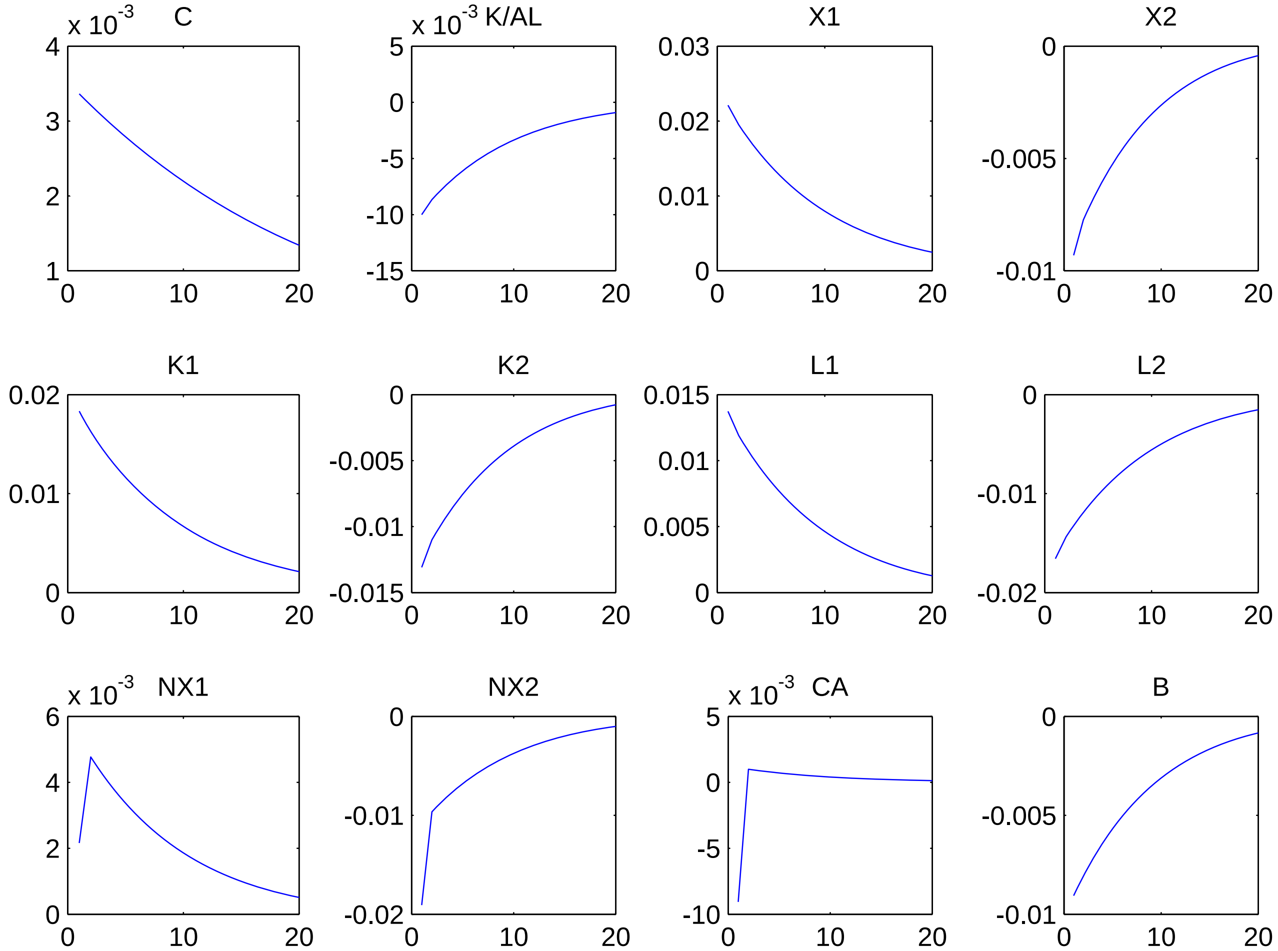


Figure 5: Impulse response to a temporal beta shock without labor market friction

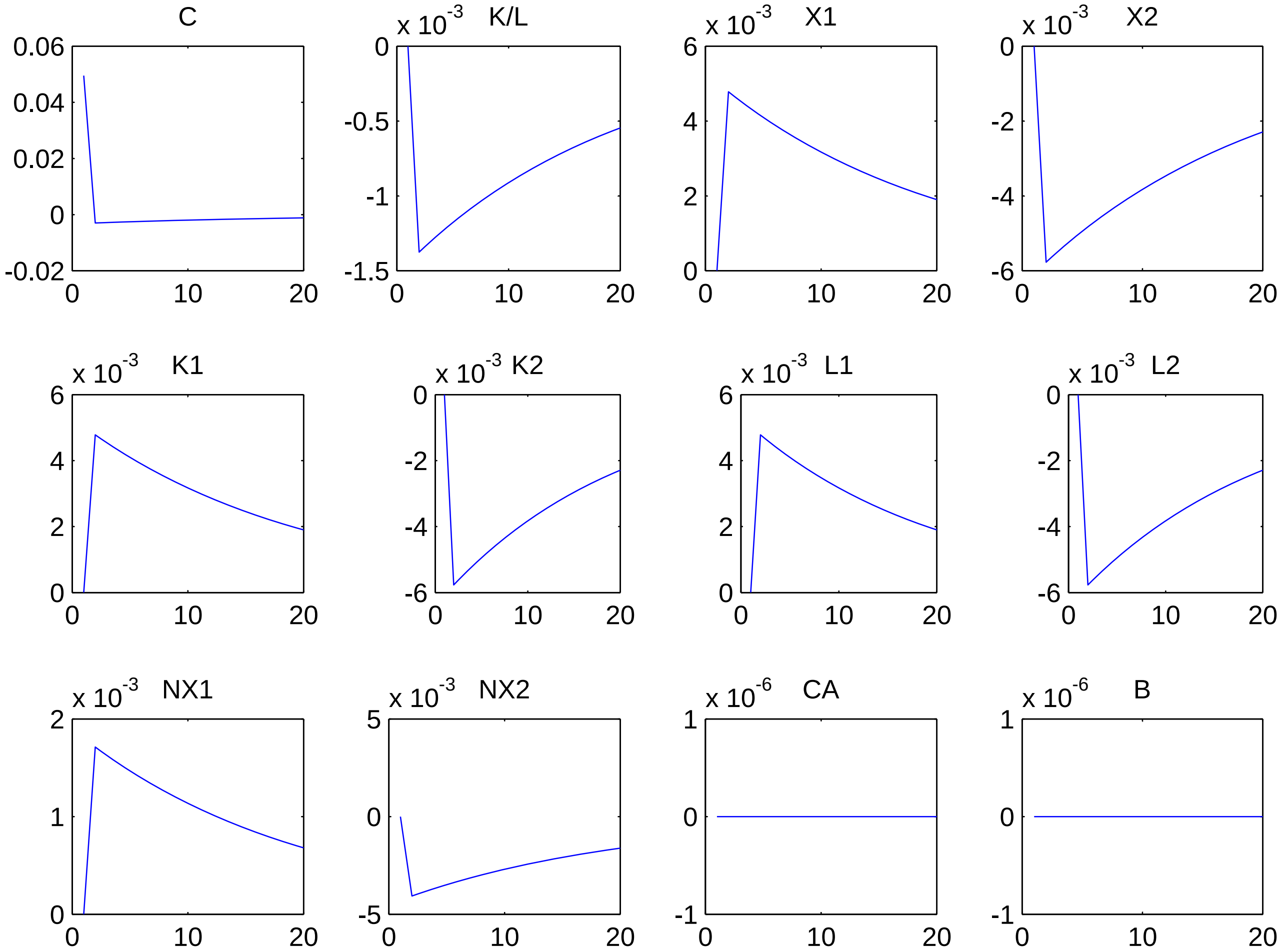


Figure 6: Impulse response to a temporal beta shock with labor market friction

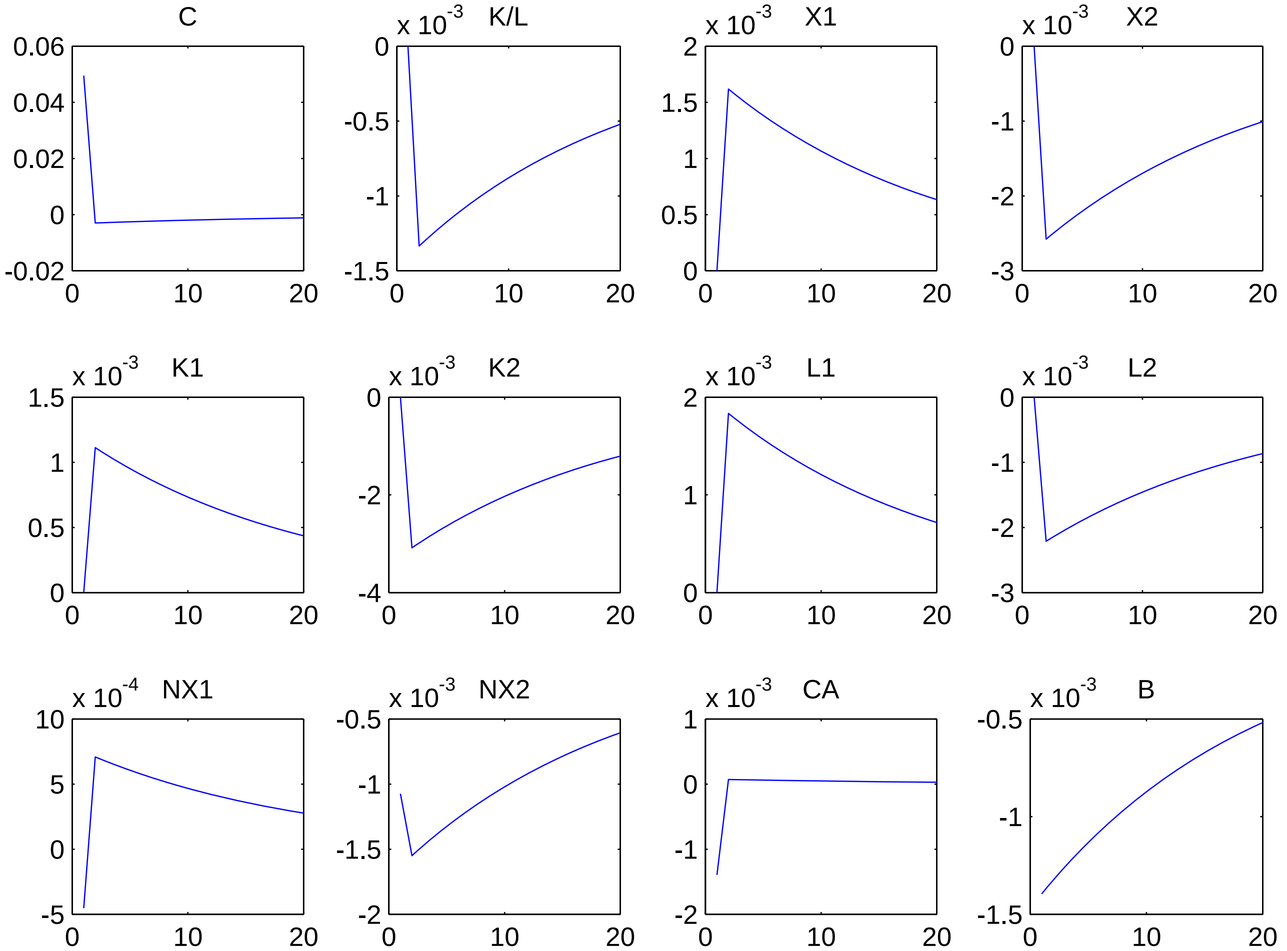


Figure 7: Impulse response to a persistent beta shock without labor market friction

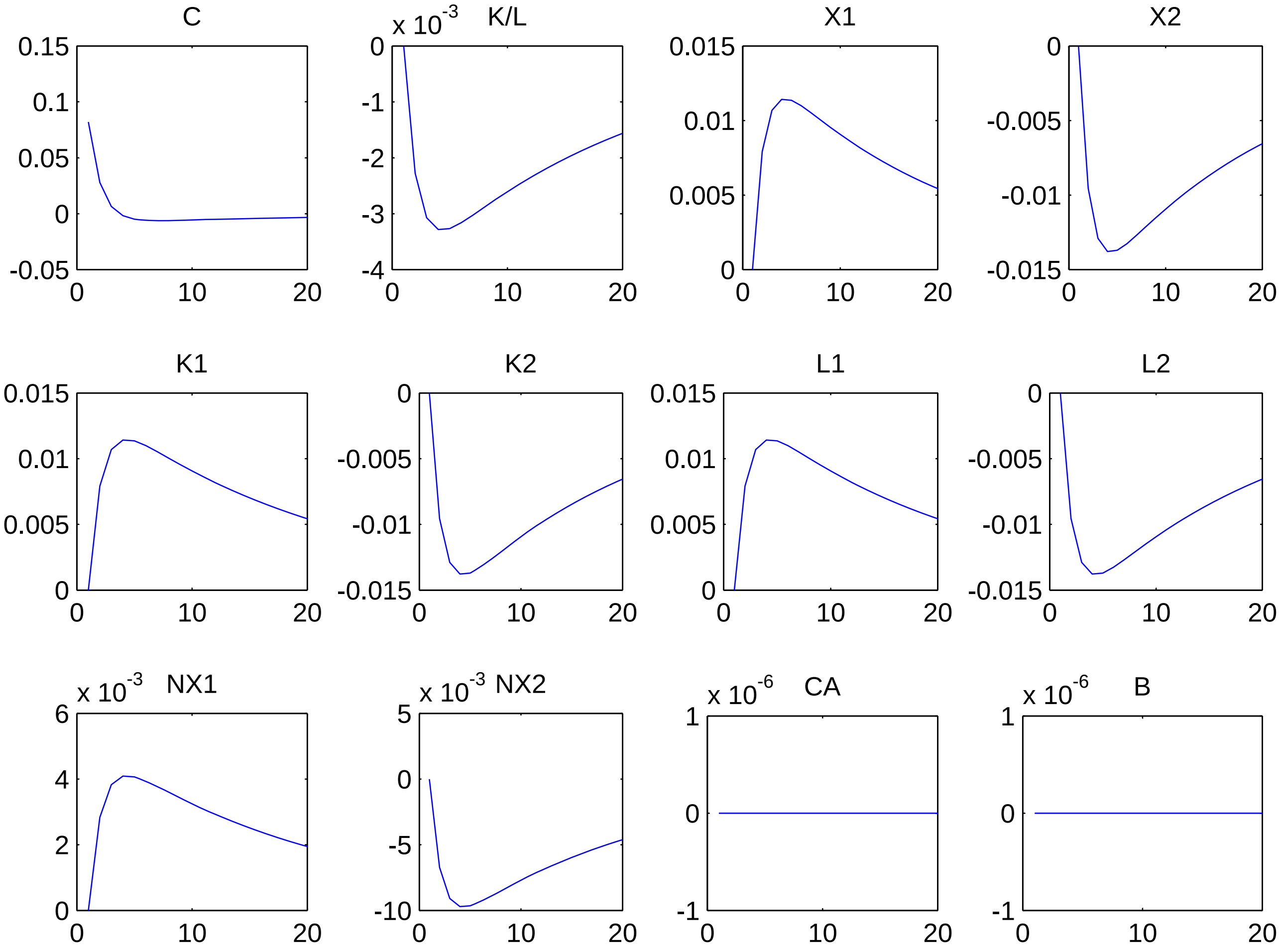
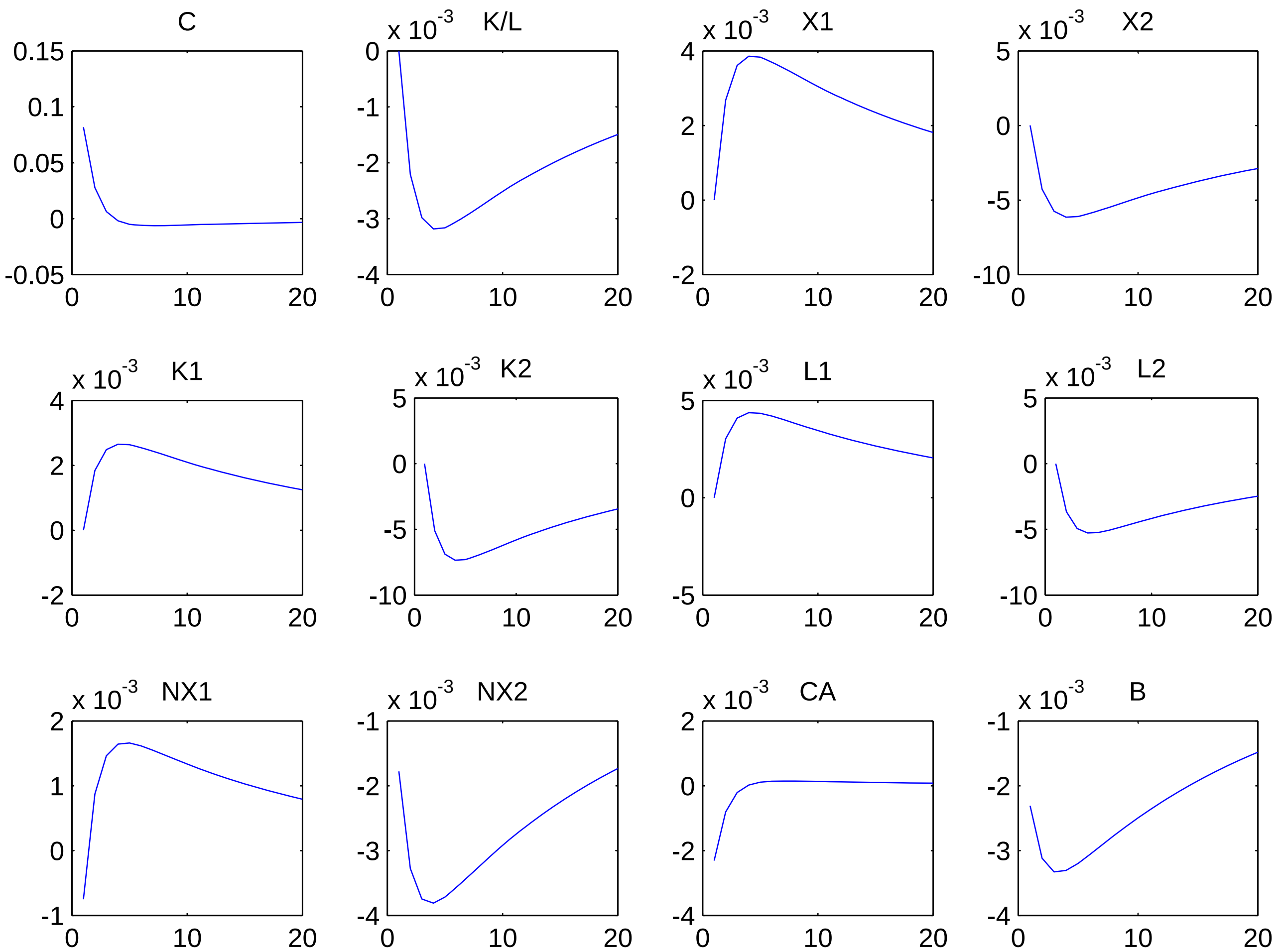


Figure 8: Impulse response to a persistent beta shock with labor market friction



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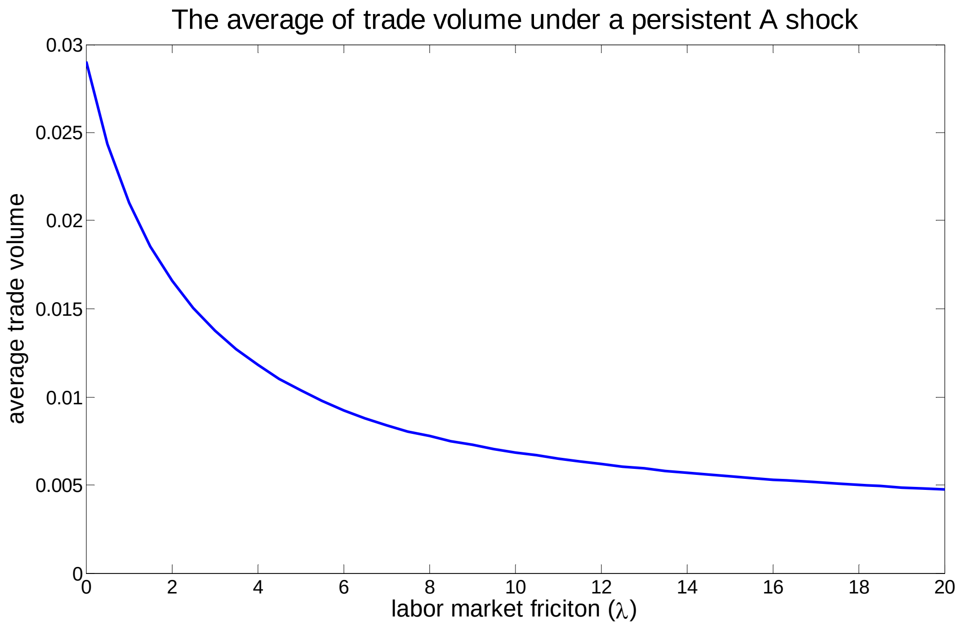

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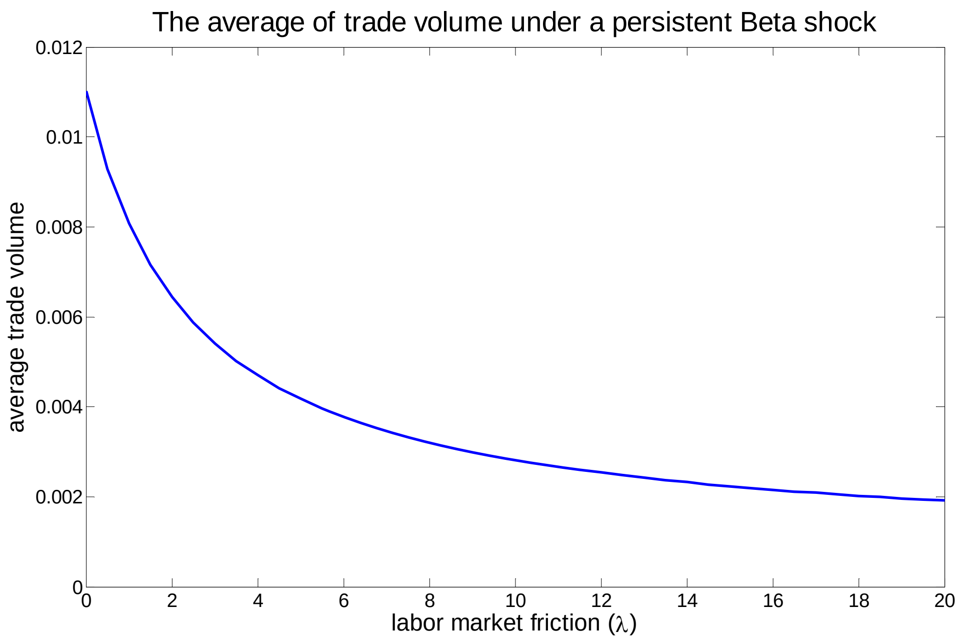

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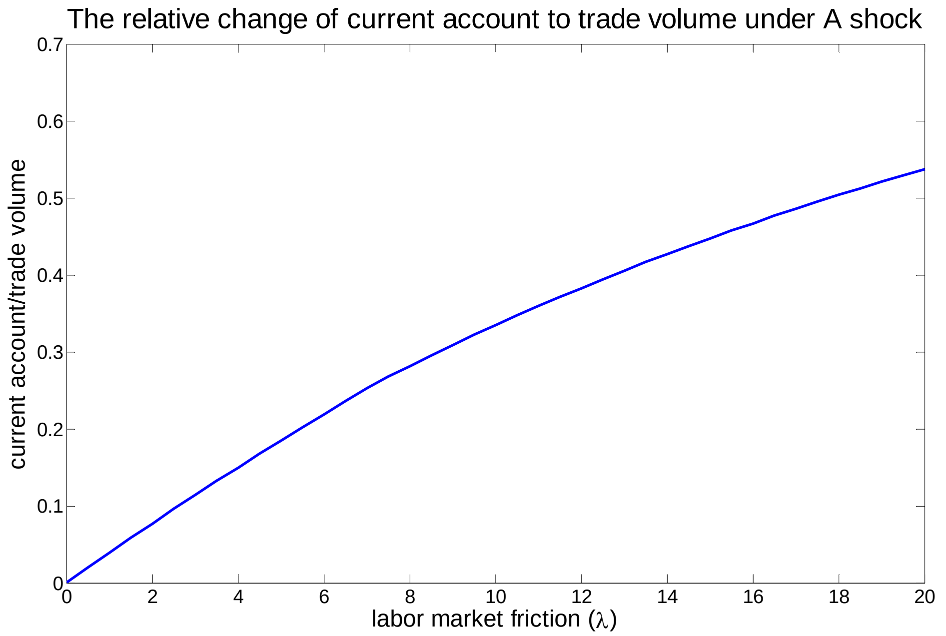

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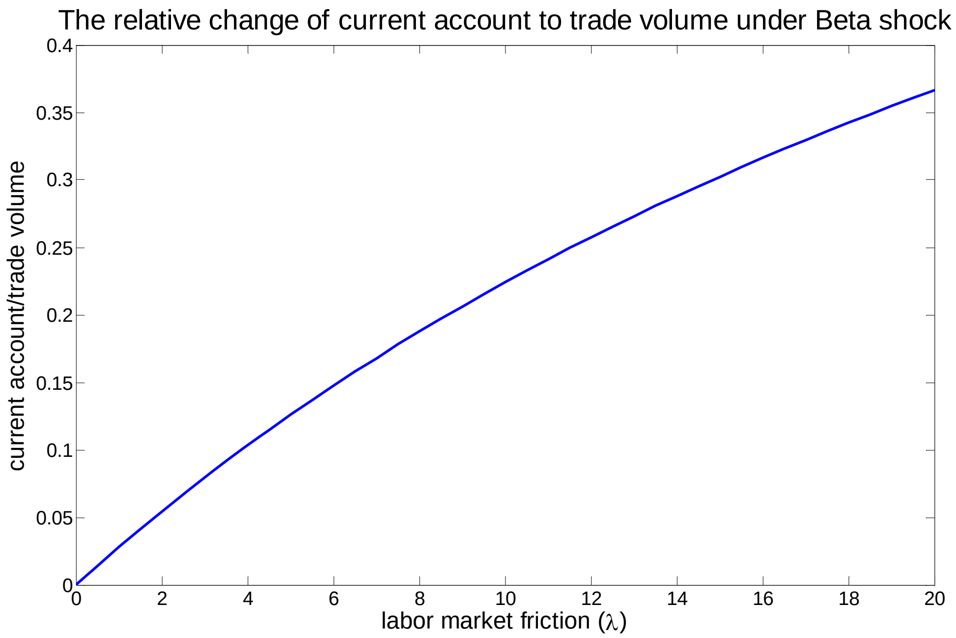

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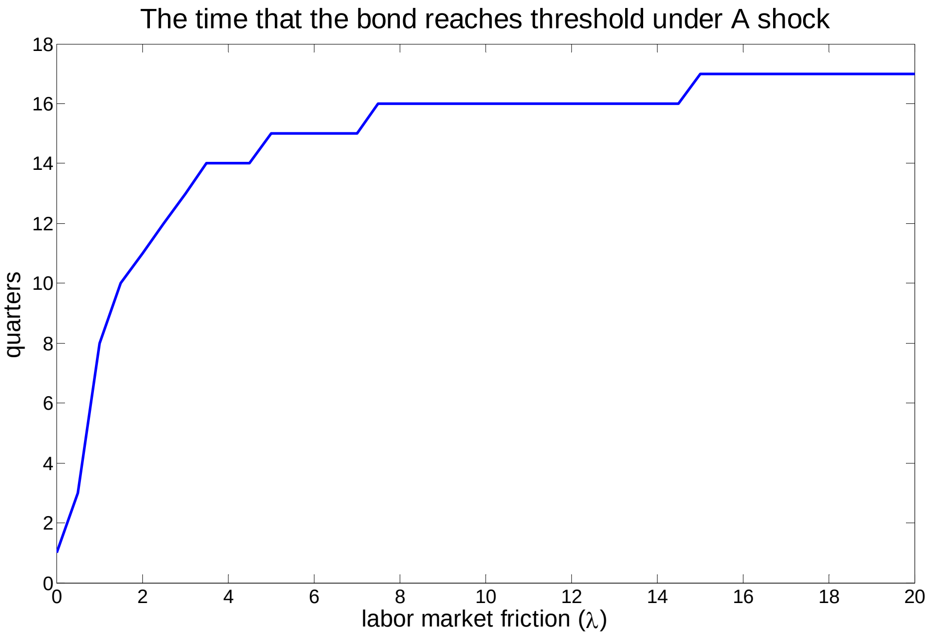

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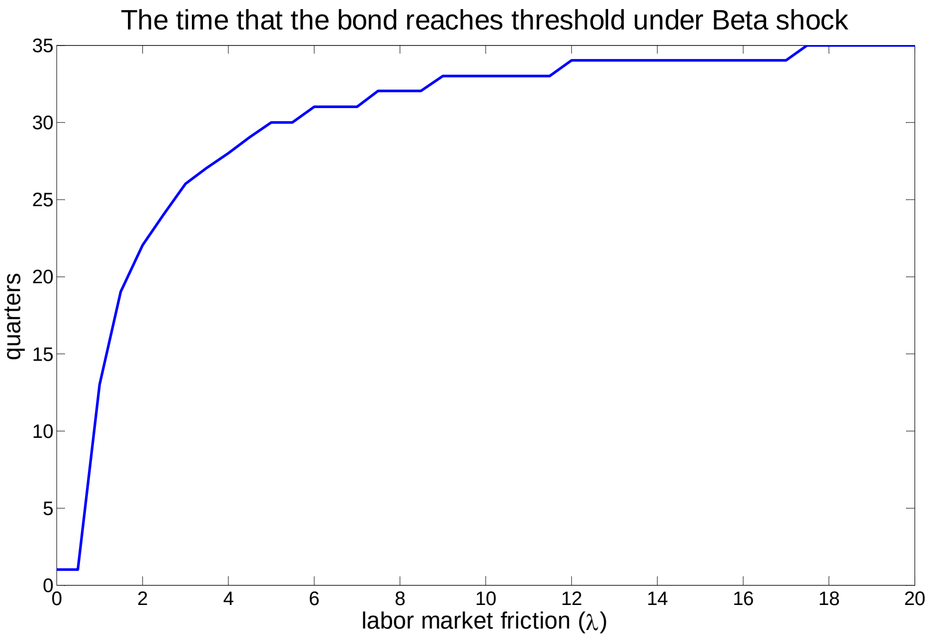


Figure 15:

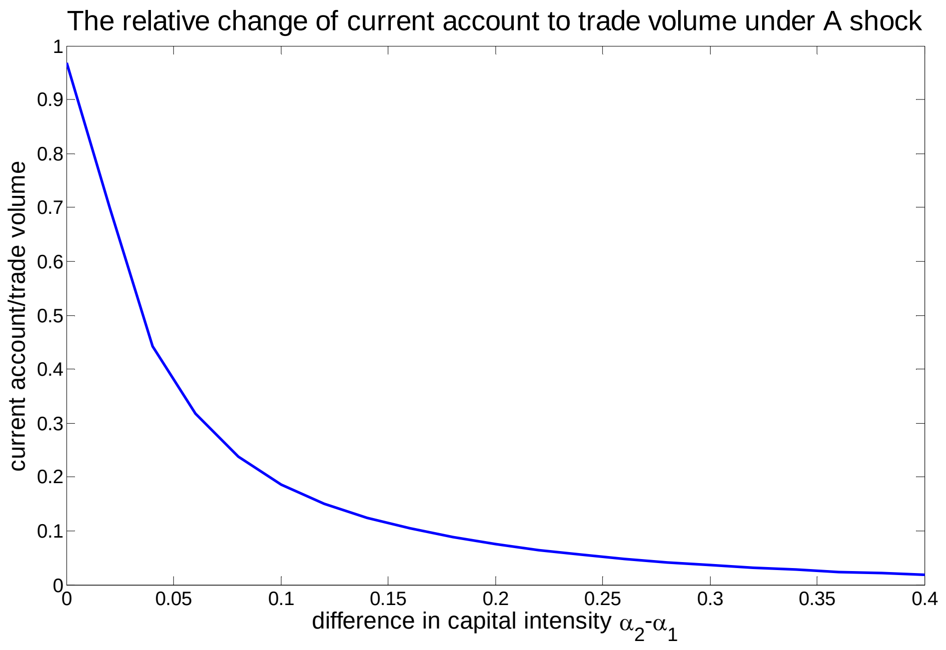
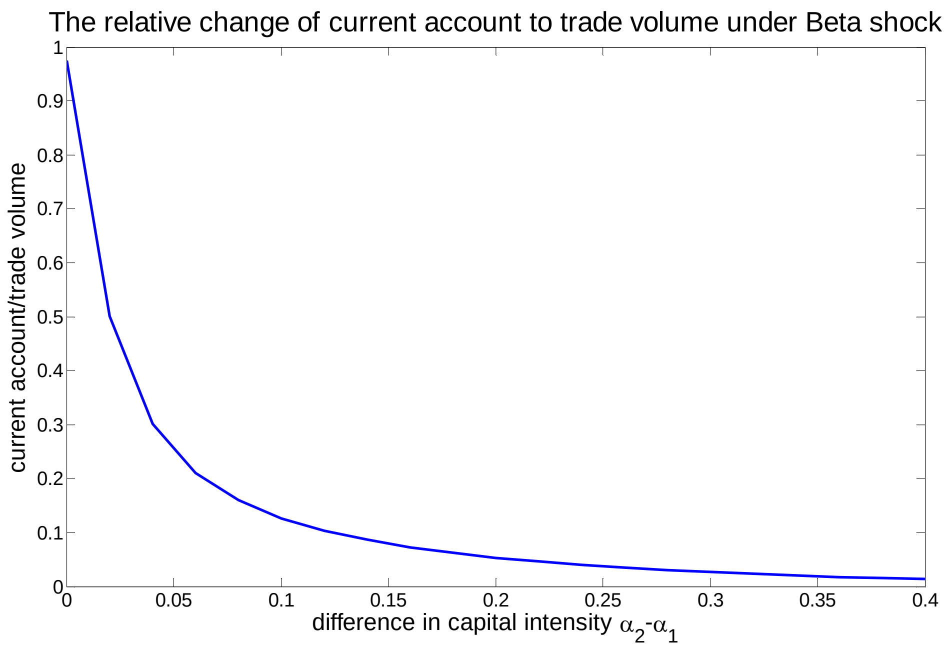


Figure 16:



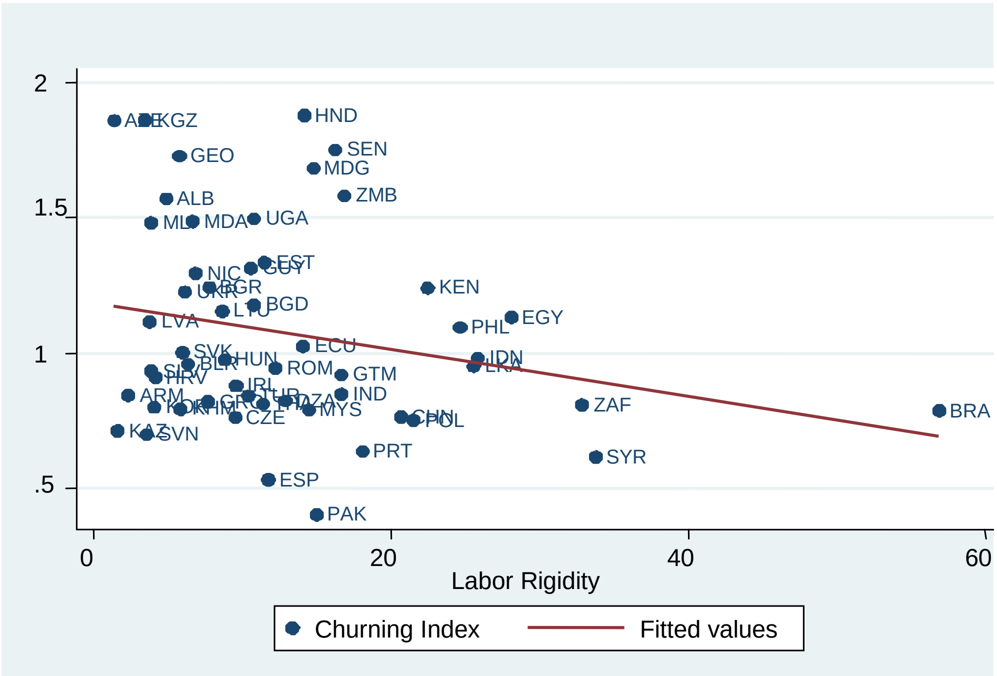


Figure 17: Trade Structure Churning vs Labor Market Rigidity, All Sectors

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

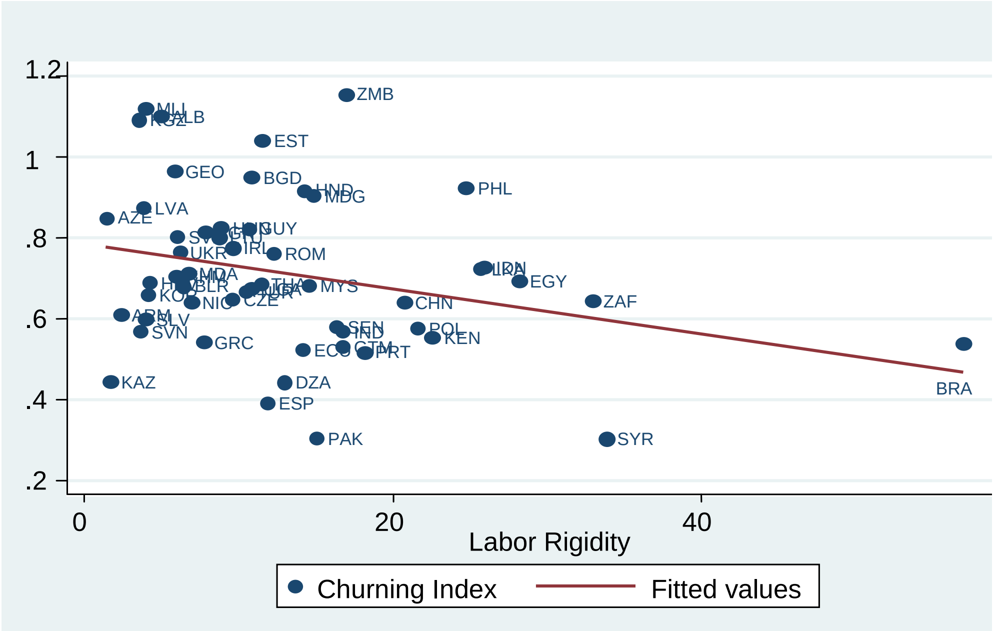


Figure 18: Trade Churning vs Labor Market Rigidity, Excluding Agriculture

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

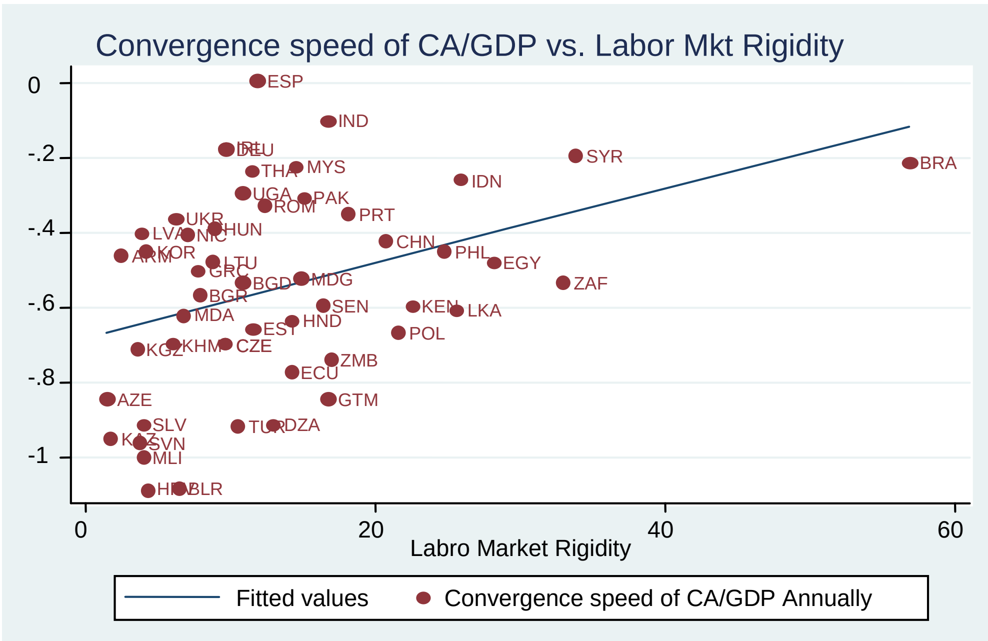


Figure 19: Convergence Speed of CA/GDP vs Labor Market Rigidity

(based on Column 1 of Table 4; Convergence speed estimated with annual data)

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

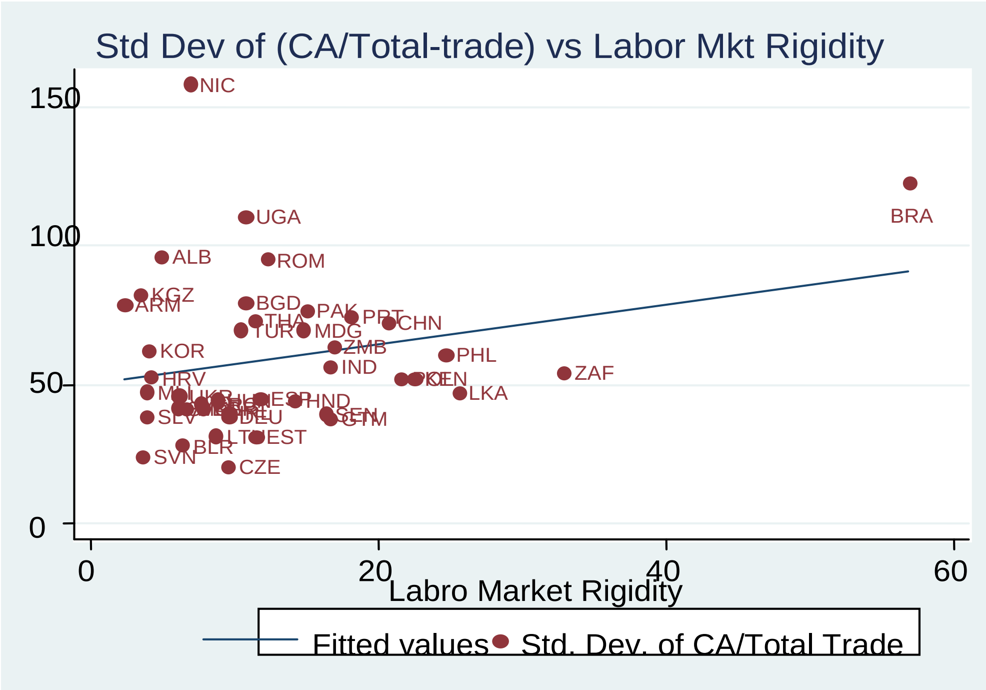


Figure 20: Standard Deviation of (CA/Total Trade) vs Labor Market Rigidity

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

Table 2: 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'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 3: Labor Market Rigidity and Convergence Speed of CA/GDP
(with Convergence Speed Estimated with Quarterly Data, Controlling for Seasonality)

	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q	b1Q
Labor market rigidity	1.063 (0.536)*	1.174 (0.615)*	1.16 (0.621)*	1.214 (0.562)*	1.192 (0.566)*	1.108 (0.575)*	1.077 (0.585)*
Exchange rate: crawling peg		-0.173 (0.20)	-0.217 (0.21)	-0.173 (0.19)	-0.219 (0.20)		
Exchange rate: managed float		-0.206 (0.25)	-0.212 (0.25)				
Exchange rate: float		(dropped)	(dropped)				
Exchange rate: free falling		-0.257 (0.21)	-0.239 (0.21)				
Exchange rate: dual market		-0.182 (0.41)	-0.177 (0.41)				
Exchange rate: managed float, float, free falling or dual market				-0.24 (0.19)	-0.229 (0.19)		
Exchange rate: float						-0.184 (0.14)	-0.153 (0.15)
Exchange rate: intermediate						0.004 (0.18)	0.041 (0.20)
Log GDP / capita [10,000US$]			0.109 (0.14)		0.112 (0.13)		0.071 (0.13)
Constant	-0.57 (0.090)*	-0.405 (0.179)*	-0.437 (0.185)*	-0.408 (0.171)*	-0.441 (0.177)*	-0.491 (0.111)*	-0.54 (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 4: Labor Market Rigidity and Convergence Speed of CA/GDP (with Convergence Speed Estimated with Annual Data)

	b1A	b1A	b1A	b1A	b1A	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 5: 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 R-squared	30 0.13	30 0.2	30 0.26	30 0.18	30 0.25	30 0.15	30 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 6: 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 7: 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, free falling or dual market			14.701				8.405	
			(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.

Table 8: List of countries in regressions

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

AR and TAR indicate data availability for the regressions based on autoregressive process (AR) and threshold autoregressive process (TAR) 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.

Table 9: Description of exchange rate regime classifications in 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