# Are Trade Liberalizations a Source of Global Current Account Imbalances?

Jiandong Ju*, Kang Shi**, Shang-Jin Wei***

September, 2011

Preliminary and Incomplete, Please do not circulate

**Abstract**

A wave of trade liberalizations take place in both developing and developed countries, including China's WTO accession and the end of import quotas on textile and garment in the United States and Europe. At the same time, both China's current account surplus and the US deficit have risen to an unprecedented level. Are these developments related? We study how trade reforms a ect current accounts by embedding a modified Heckscher-Ohlin structure and an endogenous discount factor into an intertemporal model of current account. We show that trade liberalizations in a developing country would generally lead to capital outflow. In contrast, trade liberalizations in a developed country would result in capital inflow. Thus, trade reforms can contribute to global imbalances.

**JEL Classification Numbers:** F3 and F4

*Tsinghua University and University of Oklahoma, E-mail: jdju@ou.edu; **Chinese University of Hong Kong, E-mail: kangshi@cuhk.edu.hk; ***Columbia Business School, CEPR, CIER, and NBER, E-mail: shangjin.wei@columbia.edu, Web page: www.nber.org/∼wei. We thank Stephanie Schmitt-Grohe, Michael Song, Martin Uribe and seminar participants at Columbia University and the World Bank for helpful comments. All errors are our responsibilities.

# 1 Introduction

A wave of trade liberalizations have taken place in both developing and developed countries in the last two decades. Global capital flows and global imbalances have also risen to an unprecedented level. Figure 1 displays the main patterns of global imbalances since 1980. Starting in 1991 the U.S. current account deficit worsened continuously, reaching 6.4 percent of U.S. GDP in the fourth quarter of 2005, then falling back to 5 percent of GDP by early 2008. The current account surpluses that were the counterpart of the U.S. deficits initially emerged in Japan and Western Europe were bolstered by surpluses in emerging Asia and the commodity-producing countries after 1997. Jaumotte, Lall, and Papageorgiou (2008) illustrate the wave of trade liberalizations. World trade, measured as the ratio of imports plus exports over GDP, has grown five times in real terms since 1980. All groups of emerging market and developing countries, when aggregated by income group, have been catching up with or surpassing high-income countries in their trade openness. In particular, the ratio

sectors. In general equilibrium (and ignoring the non-tradable sector for simplicity), the export sectors would expand in response. Since the export sectors use less capital per unit of labor, full employment of labor would imply that China would have an "excess" of capital, for a given level of savings, as a result of its trade liberalization. When the "excess" capital is exported abroad, China's current account surplus increases. This heuristic explanation takes savings as given. Of course, savings would be endogenous in a dynamic model. The first key objective of this paper is to clarify when this general equilibrium e ect can happen in a dynamic model.

Factor market frictions could a ect the current account response to trade reforms by blocking or slowing down structural transformations. The second key objective of the paper is to study interactions between trade reforms and factor market frictions. We focus on credit constraints and follow the modeling choice of Antras and Caballero (2009). We find that with credit constraints, trade reforms in a developing country tends to produce a current account surplus, but with a magnitude that is smaller than without credit constraints. This suggests that trade reforms that are also accompanied by factor market reforms are likely to produce greater current account responses.

It is important to note that trade liberazations would generally induce an opposite current account response in a high-income (or capital abundant) country. Reductions in trade barriers in a capital-abundant country tends to be concentrated in the labor-intensive sector, causing a contraction of the labor-intensive sector and an expansion of the capital-intensive sector. At a given savings rate, the country would experience a shortage of capital and a rise in the return to capital. This would attract a capital inflow, i.e., creating a current account deficit.

In the last part of the paper, we o er an interpretation of the Chinese experience with trade reforms and current account in the recent years. First, the trade reforms embedded in China's WTO accession are much deeper and wider than those that took place before the accession. Trade reforms take the form of dismantling a slew of non-tari barriers as well as reductions in tari rates. The accession also brought about a significant reduction

in trade costs for exporting firms. Most notably, before the accession, a separate license was required for any producer to engage in exports and imports, and only a small fraction of firms had the right to engage in international trade. As part of the reform commitments in the accession protocol, all producers automatically acquire the right to engage in trade. According to our theory, such reductions in trading cost should lead China to export capital or run a current account surplus.

By coincidence, the MFA quotas were phased out by the end of 2004, and the Chinese textiles and garment producers turned out to be one of the largest producers. This would generate a surplus in China's current account. Given China's size, the rest of the world has to have a matching current account deficit. Moreover, the end of MFA also represents one of the most significant trade liberalizations for the United States (and to a less extent, the European Union) in the recent years. This, by itself, could generate a current account e ect for these countries. If the United States has a more flexible labor market than the European Union, our theory would predict that the e ect is stronger for the United States.

The Chinese WTO accession also accelerated financial sector reforms in the country. In particular, as part of the accession obligations, China opened up the investment banking business over a three-year period, and commercial banking business over a five-year period. By the end of 2006, the share of lending that was conducted by banks outside the traditional top-4 state-owned banks had gone up substantially. The stock market listing criteria were reformed so that more non-state-owned firms obtained a chance to be listed on the stock market. Both venture capital and private equity markets have developed. Overall, the access to finance by private firms, while still less than perfect, has nonetheless improved measurably. According to our theory, this financial sector reform should complement the trade reforms and help produce an even bigger current account surplus than otherwise would have been the case.

In terms of the research question addressed, this paper is related to several papers on the cause of global current account imbalances. Caballoro, Farhi, and Gourinchas (2009) highlight the role of di erence in financial development. Countries with a relatively low

financial development (e.g., China) cannot produce enough financial assets at home to absorb all the savings. As a result, they have exported part of their savings to countries with better financial development (e.g., the United States). As a result, countries like China run a current account surplus, and countries like the United States run a deficit. Song, Storesletten and Zilibotti (2011) also feature the role of financial imperfections in China in generating its current account surplus. It stresses the inability by productive domestic private firms to borrow from the formal financial sector as the key financial sector frictions. As the share of these firms grow in the economy, so does the country's current account surplus. In both papers, when China's financial market develops (including improvement in the access to finance by private firms), the country's current account surplus should decline rather than increase. This appears to be the opposite of what one observes in the data. This suggests that one may need to combine financial underdevelopment with something else to make the model fit the data. A di erent theory about the rise of current account imbalances is given by Du and Wei (2010), which suggests that a rise in the relative surplus of men in China since 2002 may have triggered a competitive race to raise household savings by families with a son. As the sex ratio deteriorates progressively, the faster rise of the savings rate than investment rate produces a progressively larger current account surplus since 2002. Wei and Zhang (2011) provide empirical evidence that suggests that higher sex ratios may explain about 50-60% of the increase in Chinese household savings from 1990 to 2007. While this paper also examines the cause of the Chinese current account surplus (and the global current account imbalances in general), the underlying mechanism is very di erent. Logically, these explanations (financial development, sex ratio imbalance, and trade reforms) can be compatible with each other, and collectively generate the type of current account imbalances that we see in the data.

A few papers have examined the empirical relationship between trade reforms and current account such as Ostry and Rose (1992) and Ju, Wu, and Zeng (2010). They generally find that the relationship is ambiguous. Our model provides a natural explanation: the e ect of the current account response to trade reforms depends on whether the country

is capital abundant or labor abundant, and also on the nature of domestic factor market frictions. When one mixes di erent types of countries in a sample, and disregards factor market features, it is not surprising to find an ambiguous e ect.

In terms of modeling methodology, our paper is related to a small but growing literature that considers multiple tradable sectors with di erent factor intensities in a general equilibrium framework. These papers include Cunat and Ma ezzoli (2004), Ju and Wei (2007), Jin (2009 and 2010), and Ju, Shi and Wei (2011). None of the existing papers in this literature explicitly studies the e ect of trade liberalizations and therefore do not link the patterns of global current account imbalances to China's WTO accession, the end of MFA quotas and other trade reforms.

## 2 The Basic Model

Our model marries a Heckscher-Ohlin structure (with two tradable sectors of di erent factor intensities) and a small open economy dynamic general equilibrium framework. It has two additional twists. First, we incorporate a version of an endogenous discount factor following Uzawa (1968), Obstfeld (1982), Mendoza (1991), Uribe (1997), Schmitt-Grohe (1998), Choi, Mark, and Sul (2008), among others. Second, we follow Neumeyer and Perri (2005) and Schmitt-Grohe and Uribe (2003) to assume convex costs of adjusting the international asset position.

The usual motivation for an endogenous discount factor in a dynamic open-economy model is either to make the steady state independent from initial conditions or to make the current account adjustment more persistent. We assume an endogenous discount factor primarily to solve the challenge of over-determination of the interest rate. In the standard intertemporal model of current account, the interest rate in the steady state is determined by the time discount factor from the demand side. In the HO model, the interest rate is determined by the zero profit conditions from the supply side. With a permanent shock such as trade liberalization hits the economy, the steady states before and after shocks di er. As a result, the two interest rates as determined by the discount factor and as determined by

the zero profit conditions are not equal except by coincidence. This problem was raised by Stiglitz (1970) when he shows that unless two countries have identical discount factors one country must specialize in a dynamic HO model. Once we introduce an endogenous discount factor, the interest rate is determined by the zero profit conditions in the HO model. For any given interest rate, through endogenous discount factor, the total consumption in the steady state is then determined.

Convex adjustment costs for international asset position can also make the steady state independent of initial conditions. In our context, this assumption helps to address another technical challenge that has to do with the inherent multiplicity of equilibria in the standard HO model when both goods trade and capital flows are considered. As Mundell (1957) pointed out, goods trade and capital flow are perfect substitutes in the frictionless HO model. Because an infi

where $\quad_s$ is the household's consumption of a final good at date $\quad$, and $\quad_s$ is the discount factor between period $0$ and $\quad$ as given by

$$_{s+1} = \quad (\tilde{\ }_s \ \tilde{\ }_s) \ _s \quad \geq 0 \tag{2.1}$$

where $\quad_0 = 1$ and $\frac{\partial\beta(\tilde{C}_s)}{\partial\tilde{C}_s} \quad 0$ and $\frac{\partial\beta(\widetilde{Y}_s)}{\partial\widetilde{Y}_s} \quad 0$. We assume that the endogenous discount factor does not depend on the household's own consumption and income, but rather on the economy-wide average per capita consumption $\tilde{\ }_s$ and income $\tilde{\ }_s$, which the representative household takes as given.[2] The exact functional form of $(\tilde{\ }_s \ \tilde{\ }_s)$ will be presented later. The household owns both factors of production, capital $\quad$ and labor $\quad$. For simplicity, we assume a fixed labor supply.

The final good is produced by combining two intermediate goods. Each intermediate good is produced by combining capital and labor. The household supplies labor to both intermediate good sectors through a competitive spot market. In the benchmark model, both labor and capital are assumed to be freely mobile across sectors. Factor market frictions will be discussed later. The household can hold foreign asset $\quad_t$ to smooth consumption. Following Neumeyer and Perri (2005), we assume that trade in foreign bonds is subject to a small and convex portfolio adjustment costs. If the household holds an amount $\quad_{t+1}$, then these portfolio adjustment costs, denominated in units of the final good, are $\frac{\psi_b}{2}(\quad_{t+1} - \bar{\ })^2$ [3] where $\bar{\ }$ is an exogenous capacity level of foreign asset management. For simplicity, we assume $\bar{\ } = 0$.

Therefore, the budget constraint and the capital accumulation equation faced by the representative household are given, respectively, by

$$\begin{aligned} & _t[\ _t + \frac{b}{2}(\ _{t+1} - \bar{\ })^2] + \ _{t+1} + \ _t \\ = \ & _t \ + \ _t \ _t + (1 + \ ^*) \ _t + \ _t \end{aligned} \tag{2.2}$$

[2] This preference specification was pioneered by Uzawa (1968) and applied to the small open economy literature by Obstfeld (1982) and Mendoza (1991).

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

$$_{t+1} = (1 - \quad) \quad _t + \quad _t - \frac{1}{2} \quad _k(\frac{_t}{_t} - \quad)^2 \quad _t \tag{2.3}$$

where $_t$ is investment in period , and $_t$ and $_t$ are the wage and the domestic return to capital, while $^*$ being the world interest rate. is the capital appreciation rate and $_k$ is the aggregate capital adjustment cost coe cient. The tari revenue, $_t$ is rebated in a lump sum to the representative consumer, which is taken as exogenous by the consumer.[4]

The first order conditions with respect to $_t$ $_t$ $_{t+1}$ and $_{t+1}$ give intertemporal and intra-temporal optimization conditions

$$\frac{_c'(\quad _t)}{_t} = \Omega_t \tag{2.4}$$

$$\Lambda_t(1 - \quad _k(\frac{_t}{_t} - \quad)) = \Omega_t \tag{2.5}$$

$$\Lambda_t = \quad (\tilde{\ }_t, \tilde{\ }_t) \left[\Lambda_{t+1} \left(1 - \quad + \frac{_k}{2}(\frac{_t}{_t} - \quad)(\frac{_t}{_t} + \quad)\right) + \Omega_{t+1} \quad _{t+1}\right] \tag{2.6}$$

$$\Omega_t \left[1 + \quad _b \quad _t(\quad _{t+1} - \bar{\ }) \right] = \quad (\tilde{\ }_t, \tilde{\ }_t)[\Omega_{t+1}(1 + \quad ^*)] \tag{2.7}$$

where $\Omega_t$ and $\Lambda_t$ are Lagrange multipliers for the budget constraint, the law of motion for capital, respectively.

## 2.2 Production

The production function for the final good is $_t = \quad (\quad _{1t} \quad _{2t})$ where $_{it}$ is the usage of intermediate good by the final good producer. The production function for the intermediate good $(= 1 \ 2)$ is $_{it} = \quad _i(\quad _t \quad _{it} \quad _{it})$ where $_{it}$ measures labor productivity. $_{it} = \quad _{it} \quad _{it}$ can be understood as units of *effective labor.* All production functions are assumed to be homogeneous of degree one. $_{it}$ and $_{it}$ can di er due to international trade.

The unit cost function for $_{it}$ is $_i(\frac{w_t}{A_t} \quad _t)$. Let $_i$ be the domestic price of intermediate good We assume that the country's endowment is always within the diversification cone

[4] See Devereux and Lee (1999) for a similar assumption.

so that both intermediate goods are produced. In each period , free entry and zero profits in both the intermediate good and the final good markets imply that

$$_{1t} = \ _{1}(\frac{t}{_{1t}} \ \ _{t}) \quad _{2t} = \ _{2}(\frac{t}{_{2t}} \ \ _{t}) \tag{2.8}$$

$_{t}$

Equation (2.14) implies that the final good is used not only for consumption and investment, but also for covering the costs of adjusting the international asset position. The current account balance over period is defined as $\quad_t = \quad_{t+1} - \quad_t$; thus, noting that $\quad_{it} = \quad_t \quad_{it} + \quad_t \quad_{it}$ and using equations (2.9) and (2.14)), we can rewrite the budget constraint as

$$\quad_t = \quad^*_{1t}(\quad_{1t} - \quad_{1t}) + \quad^*_{2t}(\quad_{2t} - \quad_{2t}) + \quad_t + \quad^* \quad_t \tag{2.15}$$

That is, the current account balance is equal to the trade balance (evaluated at the world prices) plus the interest income from the net foreign asset position. For future reference, we define the domestic gross product as $\quad_t = \frac{P_1 X_{1t} + P_2 X_{2t}}{P_t}$.

# 3 Equilibrium Analysis

To study the equilibrium explicitly, we adopt the following standard functional forms for preference and technology. The utility function is $(\quad_t) = \frac{C_t{}^{1-\gamma}}{1-\gamma}$, where is the inverse of the elasticity of intertemporal substitution. The production function for the final good is $(\quad_{1t} \quad_{2t}) = \frac{1}{\omega^\omega (1-\omega)^{1-\omega}} \quad^{\omega}_{1t} \quad^{1-\omega}_{2t}$, where is the share of intermediate goods $\quad_1$ in the final good production. The production function for intermediate good is $\quad_i(\quad_{it} \qquad_{it}) = \frac{1}{\alpha_i^{\alpha_i}(1-\alpha_i)^{1-\alpha_i}} \quad^{\alpha_i}_{it}(\quad_{it} \quad_{it})^{1-\alpha_i}$, where $\quad_i$ is the capital share in producing intermediate good . We let $\quad_1 \qquad_2$ so that sector 1 is labor intensive. The endogenous discount factor takes the following function form:

$$(\tilde{\quad}_t) = \quad (\frac{\tilde{\quad}_t}{\bar{\quad}})^{-\psi_1} (\frac{\tilde{\quad}_t}{\bar{\bar{\quad}}})^{\psi_2} \tag{3.1}$$

where $\quad_1 \quad 0$ and $\quad_2 \quad 0$. $\bar{\quad}$ and $\bar{\bar{\quad}}$ are, respectively, the consumption and output levels in the initial steady state with tari $\quad_0$. This form is a variant of Choi, Mark and Sul (2008). It implies that in the steady state after tari reforms, the endogenous discounted factor would deviate from the constant . To make the model parsimonious, we assume $\quad_1 = \quad_2 = \quad$.

### 3.1 The Effect of Trade Liberalizations in the Steady State

For simplicity, we assume that $^{*}_{1} = \ ^{*}_{2} = 1$. In equilibrium, given the production functions, from Equation (2.8), we have

$$(\frac{\ }{_1})^{1-\alpha_1} \ ^{\alpha_1} = \ ^{*}_{1} \ (\frac{\ }{_2})^{1-\alpha_2} \ ^{\alpha_2} = (1+ \ ) \ ^{*}_{2} \tag{3.2}$$

which give

$$= \ ^{*}[(\frac{1}{_2})^{(1-\alpha_1)(1-\alpha_2)} \frac{1}{(1+ \ )^{(1-\alpha_1)}}]^{\frac{1}{\alpha_1-\alpha_2}} \tag{3.3}$$

$$= \ ^{*}[\frac{^{(1-\alpha_1)\alpha_2}_{1}}{^{\alpha_1(1-\alpha_2)}_{2}} \frac{1}{(1+ \ )^{\alpha_1}}]^{\frac{1}{\alpha_2-\alpha_1}} \tag{3.4}$$

Three comparative statics can be immediately seen: (a) $\frac{\partial r}{\partial \tau} \quad 0$ (b) $\frac{\partial r}{\partial A_1} \quad 0$ and (c) $\frac{\partial r}{\partial A_2} \quad 0$ By Inequality (a), trade liberalization in a labor abundant country (a reduction in ) reduces the return to capital.[5] Inequalities (b) and (c) pertain to sector-biased productivity shocks. While a technological progress in the labor intensive sector reduces the return to capital, the same change in the capital intensive sector produces the opposite e ect. It can be verified that, as long as there is a faster technology progress in the labor intensive sector relative to the capital intensive sector ($\frac{A_1}{A_2}$ increases), the return to capital declines.

These results (in a dynamic setting) are consistent with the Stolper-Samuelson theorem in a static HO model. That is, an increase in the price of a good will increase the return to the factor used more intensively in that good, and reduce the return to the other factor. A tari reduction in the capital intensive sector implies a decrease in the price of capital intensive goods, therefore, decreases but increases.

It is worth emphasizing that the discussion points to a natural asymmetry between developed (capital abundant) and developing (labor abundant) countries. Trade liberalization

tends to reduce the domestic return to capital for a developing country, but to raise it for a developed country.

We now solve for the foreign asset holding in the steady state. Using first order conditions (2.6) and (2.7), we obtain:

$$= \frac{1}{b} \frac{{}^{*} - \quad +}{1 + \quad -} \tag{3.5}$$

The holding of foreign bond is a function of and $\frac{\partial B}{\partial r}$ $0$. That is, when the return to capital in the country decreases, capital flows out in the steady state. We summarize our discussion by the following proposition:

**Proposition 1** *Trade liberalization, or a reduction in trade costs, in a labor abundant country leads to a decrease in the return to capital in the country, which results in an increase in the position of net foreign asset holding in the steady state. A technological progress in favor of the comparative advantage sector in a labor abundant country also reduces the return to capital and produces an increase in the net foreign asset position. An opposite set of results holds when a trade liberalization, a reduction in trade costs, or a productivity increase in favor of the comparative advantage sector, take places in a capital abundant country.*

Using the Euler equation in the steady state (2.6) and the function of endogenous discount factor (3.1), we solve for the ratio of consumption to income.

$$_{y} = \overline{=}[\ (1 + \quad - \quad)]^{\frac{1}{\psi}} \tag{3.6}$$

where $_{y} = \frac{C}{Y}$ and $\overline{\ }$ and $\overline{\ }$ are the consumption and income level in initial steady state, respectiv4ÎŶSARBh@.P"6PeadTm8rere8-8.70803Tm9]TJreS3605/TT1Tf10.98008.04152.4268.4003Tm2c[Tc4

sectoral output $_1$ and $_2$ from the set of equations listed in Appendix 7.1. We can write the sectoral output as below

$$_1 \quad _1 = \frac{-(1- \quad _2)(1+ \quad )(\qquad - \quad ^* \quad )}{(1- \quad _1)-(1+ \quad )(1- \quad _2)} \tag{3.7}$$

$$_2 \quad _2 = \frac{(1- \quad _1)(1+ \quad )(\qquad - \quad ^* \quad )-(1+ \quad )}{(1- \quad _1)-(1+ \quad )(1- \quad _2)} \tag{3.8}$$

where $= \quad + \quad (1+ \quad )$ The optimization conditions for the final good producer yield $_1 \quad _1 = \qquad$ . Thus the exports of intermediate good 1 are given by

$$_1 = \quad _1( \quad _1 - \quad _1) = \quad _1 \quad _1 - \tag{3.9}$$

Finally, the factor usages and capital intensities in sector are given by

$$_i \quad = \quad _i \frac{_i \quad _i}{} \qquad _i = (1- \quad _i)\frac{_i \quad _i}{} \text{ and} \tag{3.10}$$

$$\frac{_i}{_i} \quad = \quad \frac{_i}{1- \quad _i} \tag{3.11}$$

A tari cut in the capital intensive sector will lead an expansion of the labor intensive sector, and a contraction of the capital intensive sector. As a result, labor and capital flow from the capital intensive sector to the labor intensive sector, and both exports and imports go up.

In the initial steady state, we assume that the values of the parameters are such that would make $= \quad ^*$ so that $= 0$. We cannot use the Euler equation to determine the level of aggregate consumption $\bar{}$ and output $\bar{}$ as there are multiple equilibria. As long as the country's capital-labor ratio is between $\frac{K_1}{L_1}$ and $\frac{K_2}{L_2}$ any level of capital stock could be an equilibrium. A smaller simply implies that the country would export more labor intensive good and import more capital intensive good. We use the country's export share, therefore, to select the equilibrium in the initial steady state. The mathematical derivations are relegated in the Appendix.

### 3.2 Calibration in the Basic Model

To calibrate the basic model, we follow the standard approach (as in Backus, Kehoe, and Kydland, 1992, 1994; and Kehoe and Peri, 2002) as much as possible. The parameter values are summarized in Table 1. We set the inverse of the elasticity of intertemporal substitution $= 2$, the steady state discount factor $= 0\ 99$, which implies a 4 percent annual world interest rate. We assume an equal share of the intermediate goods in the final good production, so $= 0\ 5$. We choose $_1 = 0\ 36$ and $_2 = 0\ 64$ so that (1) the average capital share of income is about 50 percent, which is close to the estimate by Bai, Hsieh and Qian (2006) for China in 2001, the year of its WTO accession; (2) the relative labor share in export sector to the non-export sector is about 1.78, which is close to our estimate from a firm-level data in China based on a survey of above-scale manufacturing firms. Following Schmitt-Grohe and Uribe (2003), the coe cient for bond adjustment costs is set at $0\ 0007$. We set capital adjustment cost $_k = 4$ so the elasticity of Tobin's Q with respect to the investment capital ratio is 0.1, which is within the range reported in the literature. We set the annual depreciation rate of capital as 10%, which implies $= 0\ 025$ We set $= 0\ 1$, which is close to the value chosen by Choi, Mark and Sul (2008).

Table 1: Parameter Values in the Calibrations

| | | |
|---|---|---|
| | the discount factor in steady state | 0.99 |
| | the inverse of the elasticity of intertemporal substitution | 2 |
| $_1$ | capital share in sector 1 | 0.36 |
| $_2$ | capital share in sector 2 | 0.64 |
| | the share of goods 1 in final good | 0.5 |
| $_b$ | the coe cient for convex bond adjustment costs | 0.0007 |
| | capital depreciation rate | 0.025 |
| | the parameter of endogenous discount factor | 0.1 |
| $_k$ | the coe cient of capital adjustment cost | 4 |
| $_1$ | productivity in sector 1 | 0.8 |
| $_2$ | productivity in sector 2 | |

We assume that in the initial steady state, the economy imposes a $15\%$ of tari on imports of the capital intensive good, while the rest of the world has no tari . For the initial productivity, we set $_1 = 0\ 8$ and $_2 = 0\ 54261$ so that in the initial steady state, given the tari , the return to capital across countries is equalized and the wage in the domestic economy is lower than that in the rest of the world. We consider a policy experiment of reducing the import tari by $5$ percentage points to $10\%$. In columns 2 and 3 of Table 2, we report the values for both the initial and the new steady states. The numerical results confirm Proposition 1 : 1) the return to capital declines while the wage rate arises; 2) the labor intensive sector expands while the capital intensive sector shrinks, and the aggregate capital usage declines; 3) the labor intensive sector exports more while the capital intensive sector imports more, and 4) capital flows out of the country. In summary, a moderate tari reduction (by 5 percentage points) results in a significant capital outflow, so that the increase in the holding foreign asset is about $40$ percent of the domestic GDP.

In Figures 4 and 5, we depict the dynamic path of the economy from the initial to the new steady state after a trade liberalization. We assume that the trade liberalization starts to hit the economy in period 1. We find that the structural adjustment takes place immediately. In particular, sector 1 (the labor intensive sector) expands immediately with an increase in $_1$ $_1$ and $_1$ while sector 2 contracts immediately, with a decline in $_2$ $_2$ and $_2$. As a result, both the export share and import share $-$ increase immediately. The import volume (as a share of GDP) rises.

The consumption response is somewhat non-standard. There is a decline in the first several periods; after that, consumption rises gradually to a higher new steady state level. Due to a sharp rise in output, we can find that the ratio of consumption to output declines, which implies a higher saving rate after a tari reduction. This is because the return to domestic capital declines, but the return to foreign asset is fixed, and therefore the household has an incentive to consume less (as a proportion of income) and send some of the savings abroad. In Figure 5, we observe that the trade volume, trade surplus and current account surplus jump immediately. While the current account stays positive throughout

the transition and approaches zero in the long run, the net foreign asset position gradually increases to the steady state level. In response to the trade liberalization, the economy runs a persistent trade surplus, initially on the order of $6$ percent of GDP. In the long run, however, the economy will run a trade deficit, which is balanced by the interest payment of the foreign asset.

As equation (3.5) indicates, the change in the foreign asset position from the initial to the new steady state is a ected by the bond adjustment cost parameter $_b$. In Figure 6, we report the transition dynamics under the assumption of two di erent values of $_b$ $0\ 0005$ and $0\ 0010$ in addition to the benchmark value of $0\ 0007$ The country still runs a current account surplus after a tari cut with each of the two alternative portfolio adjustment costs. The quantitative e ect, however, varies. As expected, a smaller bond adjustment cost results in a larger current account surplus in transition dynamics, and larger trade volume and net foreign asset position in both transition dynamics and the steady state. In Schmitt-Grohe and Uribe (2003), the parameter of bond adjustment cost is chosen to match the standard deviation of the current account/GDP ratio for Canada (which is 0.015). From the corresponding annual data for China during 1982-2010, after detrending with an HP filter, we calculate that the standard deviation of the CA/GDP ratio is 0.019, which is close to the Canadian number. Separately, in calibrating an RBC model to explain the business cycles in the Chinese economy, Curtis and Mark (2010) also choose $_b = 0\ 0007$ as the value for the bond adjustment cost. Therefore, we regard $_b = 0\ 0007$ as the "right" benchmark value.

We also report transitional dynamics when we vary the aggregate capital adjustment costs $_k = 4\ \ 8$ and $12$ Although the steady state is not a ected by changes in $_k$ the trade volume, the current account and the foreign asset position in the transition dynamics become larger when $_k$ becomes smaller.

# 4 Factor Market Frictions

For the current account to respond to trade reforms, a key intermediary step is structural adjustment of the domestic economy - the contraction of the capital intensive sector and the expansion of the labor intensive sector - leads to a mismatch between the aggregate saving and the new domestic absorption of capital. This produces a current account response. Logically, factor market frictions that block and reduce the extent of the structural adjustment can also reduce the current account response to trade reforms. In this section, we study the interactions between factor market frictions and trade reforms and their implications for the current account response. We start with financial frictions in the form of credit constraints.

## 4.1 Financial Frictions

Following Antras and Caballero (2009), we make the simplifying assumption that financial frictions are asymmetric in the two sectors: while firms in the importing sector can employ any desired amount of capital at the equilibrium interest rate, firms in the exporting sector face credit constraints. Note that with a tari cut on the capital intensive good, only the (labor-intensive) export sector would expand. Therefore, we essentially assume that credit constraints are more binding in the sector that needs expansion.

Credit constraints are introduced through the following (admittedly artificial) setting. Each capitalist owns one unit of capital so that the capital stock is owned by a total of capitalists. A proportion of are endowed with "entrepreneurial ability" and labelled "entrepreneurs". Only the "entrepreneurs" know how to operate in the exporting sector. However, each entrepreneur can borrow only up to amount of her own capital. Thus the total amount of capital employed in the exporting sector is given by,

$$_{1t} \leqslant (1 + \ ) \quad _t = \ _k \ _t \tag{4.12}$$

where $_k = (1 + \ )$ We focus on the case in which financial frictions are binding (or

is su ciently small) so that $_k$ is less than the desired amount of capital that exporting firms would like to employ in the absence of financial frictions.

Let $_i$ be the return to capital in sector The financial frictions cause a wedge between the returns to capital in the two sectors, $_{1t}$ $_{2t}$. The budget constraint (2.2) now is changed to

$$
\begin{aligned}
& {}_t[\ {}_t + \frac{b}{2}(\ {}_{t+1} - {}^{-})^2] + \ {}_{t+1} + \ {}_t \\
= \ & {}_t \ + \sum_{i=1}^{2} {}_{it} \ {}_{it} + (1 + {}^{*}) \ {}_t + \ {}_t
\end{aligned}
\tag{4.13}
$$

In addition to capital accumulation equation, the representative household also faces the credit constraint (4.12) and capital market clearing condition, $_{1t} + \ _{2t} = \ _t$. When the credit constraint (4.12) is binding, we have $_{1t} = \ _k \ _t$ and $_{2t} = (1 - \ _k) \ _t$ Using these results, the budget constraint (2.2) now becomes:

$$
\begin{aligned}
& {}_t[\ {}_t + \frac{b}{2}(\ {}_{t+1} - {}^{-})^2] + \ {}_{t+1} + \ {}_t \\
= \ & {}_t \ + [\ {}_k \ {}_{1t} + (1 - \ {}_k) \ {}_{2t}] \ {}_t + (1 + {}^{*}) \ {}_t + \ {}_t
\end{aligned}
\tag{4.14}
$$

Therefore, the first order conditions with respect to $_t$ $_{t+1}$ $_{t+1}$ and $_{it}$ in the consumer's maximization problem now remain the same as conditions (2.4), (2.6), and (2.7) except that we now replace $_{t+1}$ by

$$
{}^{C}_{t+1} = \ {}_k \ {}_{1,t+1} + (1 - \ {}_k) \ {}_{2,t+1} \tag{4.15}
$$

### 4.1.1 The Steady State Equilibrium

The steady sate equilibrium in the case of financial frictions is represented by 15 equations with 15 variables, and is summarized in Appendix 7.3. Similar to equation (3.5), in the steady state we have

$$
= \frac{1}{\ {}_b} \frac{{}^{*} - \ {}^{C} +}{1 + \ {}^{C} -} \tag{4.16}
$$

Thus, $^{C} = \ _{k}\ _{1} + (1 - \ _{k})\ _{2}$ is a key variable in determining the country's net foreign asset holding

Because we are not able to obtain an analytic solution, we will resort to numerical results. Here we o er some intuition for the numerical results to come. When financial frictions becomes tighter, the capital usage in sector 1 declines. As a result, the marginal product of capital in the exporting sector, $_{1}$ increases, but the marginal product of labor, $_{1}$ declines. Since the wage rates are equalized in the two sectors in the steady state, $_{1} = \ _{2} = \ $, using the zero profit condition in the import-competing sector, $_{2} = \ _{2}(\frac{w_2}{A_2}\ _{2})$ we infer that the marginal product of capital in the import-competing sector, $_{2}$ must rise. Since both $_{1}$ and $_{2}$ are larger, therefore, $^{C}$ becomes larger as financial frictions becomes tighter. Using (4.16), that results in a smaller That is, a lower level of financial development (a tighter credit constraint) results in a smaller net foreign asset holding. To summarize, because financial frictions impede the expansion of the exporting sector, a given trade reform produces a smaller capital outflow.

## 4.2 Labor Market Frictions

We can model labor frictions in a similar fashion and obtain qualitatively similar results. Assume that labor employed in the exporting sector requires "exporting skills", and the amount of labor with "exporting skills" does not exceed a proportion of total amount of labor. In other words, when the labor-intensive sector expands, not all labor previously working in the importing sector can successfully function in the exporting sector. As an example, when the textile industry expands but the steel mills are shut down, not all former steel workers can be productive textile workers. Formally, we model the frictions by the following inequality:

$$_{1t} \leqslant \ _{L} \tag{4.17}$$

Similarly, the budget constraint (2.2) now becomes

$$
\begin{aligned}
& {}_t[\ {}_t + \frac{b}{2}(\ {}_{t+1} - \ {}^{-})^2] + \ {}_{t+1} + \ {}_t \\
= \ & [\ {}_L\ {}_{1t} + (1 - \ {}_L)\ {}_{2t}] \ + \ {}_t\ {}_t + (1 + \ {}^{*})\ {}_t + \ {}_t
\end{aligned}
\tag{4.18}
$$

and all the analysis in the basic model goes through except that now we replace ${}_t$ by ${}^c_t = \ {}_L\ {}_{1t} + (1 - \ {}_L)\ {}_{2t}$ Labor market frictions impede the expansion of the exporting sector. Thus a given trade reform produces a smaller response in both the trade volume and the current account.

## 4.3 Numerical Results

We focus on the case of credit constraints, while assuming no labor market frictions. We choose the same structural parameters as in the benchmark case. For financial frictions, we set the credit constraint parameter in the initial steady state ${}_k = 0\ 47$ so that the initial net export share is about 10%.

The case of a tari reduction from 15% to 10% under

presented in thin broken lines. As one can see clearly, the magnitude of the response of the current account and other variables are all significantly smaller under credit constraints.

## 5 An Interpretation of the Chinese Experience

The connections between current account and trade liberalizations and between current account and sector-biased technological changes are quite general. In this section, we use the insight from our theory to interpret the Chinese current account experience. This case is chosen for two reasons. First, the rapid rise of China's current account surplus since 2002 has attracted international attention, leading to various e ort by the International Monetary Fund and the U.S. government to "correct" it. Second, China has also undertaken a number of large and unilateral trade liberalizations in the context of its accession to the World Trade Organization. If one counts the number of trade reforms China has to undertake, it is more two standard deviations greater than the median value for an accession country since 1990 (Tang and Wei, 2009). This makes it interesting to see if our theory is consistent with the Chinese experience.

will also generate a surplus in China's current account, and a deficit in the U.S. current account.

The Chinese WTO accession also accelerated financial sector reforms in the country. In particular, as part of the accession obligations, China opened up the investment banking business over a three-year period, and commercial banking business over a five-year period. By the end of 2006, the share of lending that was conducted by banks outside the traditional top-4 state-owned banks had gone up substantially. The stock market listing criteria were reformed so that more non-state-owned firms obtained a chance to be listed on the stock market. Both venture capital and private equity markets have developed. Overall, the access to finance by private firms, while still less than perfect, has nonetheless improved measurably. According to our theory, this financial sector reform should complement the trade reforms and help produce an even bigger current account surplus than otherwise would have been the case.

Figure 3 and Table A1 show that there were two phases of tari cuts in China. The first phase occurred in 1995-1996. The weighted tari was reduced about $13\%$ from $27\ 96\%$ to $15\ 15\%$ Correspondingly, the trade volume to GDP ratio slightly increased from $38\ 81\%$ to $39\ 01\%$ and the current account to GDP ratio increased from $0\ 2223\%$ to $3\ 88\%$ The second phase is WTO accession where weighted tari was reduced about $7\%$ from $13\ 36\%$ to $6\ 48\%$ This time both trade volume and current account increased much more dramatically. The trade volume to GDP ratio increased from $44\ 24\%$ in 2000 to as high as $70\ 57\%$ in 2006. The current account surplus to GDP ratio increased from $1\ 712\%$ in 2000 to $10\ 64\%$ in the peak year of 2007.

There seem to be forces deterring the structural adjustment in the first phase. One possible reason is that there are factor market frictions which prevent the structural adjustments in a full scale. Our interpretation is that, the financial market frictions in the first phase, significantly reduces the magnitude of structural adjustments due to trade liberalizations. Therefore, we do a numerical exercise, which models the tari reduction in 1990s. We assume the economy is subject to credit constraint and the initial tari is 30%.

For this experiment, we set the credit constraint parameter $_k = 0\ 516$ so that the initial trade pattern in the model is close to ratio of trade volume to GDP in 1995. We set the endogenous discount factor parameter $= 0\ 075$ so that the ratio of trade volume to GDP in the new steady state of the model is close to the data in 2000. Similarly, we set the bond adjustment cost $_b = 0\ 001$ so that the share of foreign asset to GDP in the new steady state is close to the ratio of foreign reserve to GDP in 2000. The result in Table 3 show that when there is 15% tari reduction, the trade volume/GDP increase from $30\ 9\%$ to $41\ 2\%$ and the foreign asset position increase from 0 to $13\ 7\%$. We also use the same set of parameters to do an experiment, which is similar to China's experience after 2001. It is assumed that there is no financial friction and the economy has $7\%$ tari reduction in import sector. The total e ect of the reform leads to the trade volume/GDP increase from $43\%$ to $55\ 6\%$, and the foreign asset position/GDP increase from zero to $47\ 8\%$.

## 6 Concluding Remarks

A wave of trade liberalizations take place in both developing and developed countries, including China's WTO accession and the end of import quotas on textile and garment in the United States and Europe. At the same time, both China's current account surplus and the US deficit have risen to an unprecedented level. Are these developments related? We study how trade reforms a ect current accounts by embedding a modified Heckscher-Ohlin structure and an endogenous discount factor into an intertemporal model of current account. There are two key results. First, trade liberalizations in a developing country would generally lead to capital outflow, while trade liberalizations in a developed country would result in capital inflow. Thus, trade reforms can contribute to global imbalances. Second, factor market frictions can reduce the current account response to trade reforms by reducing the extent of economic structural change.

We use the model to o er an interpretation of the Chinese experience with trade reforms and current account dynamics. Before China's accession to the WTO at the end of 2001, while there had been trade reforms, financial sector frictions may blunt the current account

response. The WTO accession represents a watershed event in two senses. First, not only the dismantling of tari  and non-tari  barriers on imports was accelerated, there was also a dramatic reduction in trading costs faced by firms in the exporting sector. The most noteworthy change is that an expansion of firms that are legally authorized to engage in international trade. Second, the accession protocol also obligates China to engage in a series of financial sector reforms over a five-year transition period after the accession. These reforms have also greatly facilitate the economic adjustment in the direction of expanding China's comparative advantage sectors and reducing its comparative disadvantage sectors. Both changes brought out by the WTO accession, in the context of our model, have the e  ect of producing a positive current account response. In fact, because both trade reforms and financial reforms were conducted over a multi-year phase, the current account response can be expected to gain strength over time in the first few years after the WTO accession before it peters o  .

The end of the import quotas on textile and garments by the United States and Europe in 2004 represents another important event that reduces trading costs. Since this was a reduction in trade barriers on a labor-intensive product in the United States, our theory would predict that the U.S. responds by running a current account deficit. More importantly, because textile and garments are an important comparative advantage sector for China, the end of quotas represented a big decline in the export costs for Chinese exporting firms. Therefore this event also reinforces the rise of China's current account surplus in recent years.

## References


[1] Antras, Pol and Ricardo J. Caballero, (2009), "Trade and Capital Flows: A Financial Frictions Perspective," *Journal of Political Economy,* 117(4), pp. 701-744.

[2] Backus, David K., Patrick J. Kehoe, and Finn E. Kydland, (1992), "International Real Business Cycles," *Journal of Political Economy* 100: 745–775.

[3] Backus, David K., Patrick J. Kehoe, and Finn E. Kydland, (1994), "Dynamics of the Trade Balance and the Terms of Trade: The J-Curve," *American Economic Review* 84:1, 84–103.

[4] Bai, Chong-En Bai, Chang-Tai Hsieh and Yingyi Qian, (2006). "The Return to Capital in China," Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, vol. 37, pages 61-102.

[5] Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier Gourinchas, (2008), "Financial Crash, Commodity Prices, and Global Imbalances," *Brookings Papers on Economic Activity*, Fall, 1-68.

[6] Choi, Horag, Nelson C. Mark, and Donggyu Sul, (2008), "Endogenous Discounting, the World Saving Glut and the U.S. Current Account", *Journal of International Economics*, 75, 30-53.

[7] Cunat, Alejandro and Marco Ma ezzoli, (2004), "Heckscher-Ohlin Business Cycles," *Review of Economic Dynamics,* 555-585.

[8] Curtis, Chadwick and Nelson Mark, (2010), "Business Cycles, Consumption and Risk-Sharing: How Di erent is China?", in Yin-Wong Cheung,Vikas Kakkar,and Guonan Ma, eds., The Evolving Role of Asia in Global Finance, forthcoming.

[9] Devereux, Michael and Khang Min Lee, (1999), "Endogenous Trade Policy and the Gains from International Financial Markets," Journal of Monetary Economics, 43, 35-59.

[10] Du, Qingyuan, and Shang-Jin Wei, 2010, "Sex Ratios, Savings Rates and Current Account Imbalances," NBER Working Paper 16000.

[11] Jaumotte, F., S. Lall, and C. Papageorgiou, 2008, "Rising Income Inequality: Technology, or Trade and Financial Globalization?" *IMF Working Paper* 08/185.

[12] Jin, Keyu, (2009), “Industrial Structure and Financial Capital Flows,” Working Paper, London School of Economics.

[13] Jin, Keyu, (2010), “International Business Cycles with Heterogeneous Sectors," Working Paper, London School of Economics.

[14] Ju, Jiandong, Kang Shi and Shang-Jin Wei, (2010), “Sticky Current Accounts versus Sticky Factor Markets: Theory and Evidence on the Substitutability between Intratemporal and Intertemporal Trades,” Working Paper, Columbia University.

[15] Ju, Jiandong and Shang-Jin Wei, (2007), “Current Account Adjustment: Some New Theory and Evidence,” NBER Working Paper 13388.

[16] Ju, Jiandong and Shang-Jin Wei, 2010, “Domestic Institutions and the Bypass E ect of Financial Globalization,” *American Economic Journal: Economic Policy*.

[17] Ju, Jiandong and Shang-Jin Wei, 2011, “When Is Quality of Financial System a Source of Comparative Advantage?” *Journal of International Economics*, forthcoming.

[18] Ju, Jiandong, Yi Wu and Li Zeng, (2010), “The Impact of Trade Liberalization on the Trade Balance in Developing Countries," IMF Sta Papers, 57(2), 427-449.

[19] Kehoe, P. J. and F.Perri, (2002), “International Business Cycles with Endogenous Incomplete Markets", *Econometrica*, 70, 907-928.

[20] Mendoza, Enrigue, (1991), “Real Business Cycles in a Small Open Economy,” *American Economic Review,* 81, 797-818.

[21] Mundell, Robert A. (1957), “International Trade and Factor Mobility," *American Economic Review, 47,* 321-335.

[22] Markusen, James R., (1983), “Factor movements and commodity trade as complements," *Journal of International Economics*, vol. 14(3-4), 341-356.

[23] Neumeyer, Pablo A., and Fabrizio Perri, 2005, "Business Cycles in Emerging Economies: The Role of Interest Rates," *Journal of Monetary Economics,* 52(2): 345-380.

[24] Obstfeld, M., 1982. Aggregate spending and the terms of trade: Is there a Laursen-Metzler e ect? Quarterly Journal of Economics 97, 251-270.

[25] Ostry, Jonathan D. and Andrew K. Rose, (1992), "An Empirical Evaluation of the Macroeconomic E ects of Tari s," *Journal of International Money and Finance*, 11: 63-79.

[26] Schmitt-Grohe, Stephanie, 1998, "The International Transmission of Econmic Fluctuations: E ects of US Business Cycles on the Canadian Economy," *Journal of International Economics*, 44: 257-287.

[27] Schmitt-Grohe, Stephanie and Martin Uribe, (2003), "Closing Small Open Economy Models," J*ournal of International Economics*, 61:163-185.

[28] Stiglitz, Joseph E, (1970), "Factor Price Equalization in a Dynamic Economy," *Journal of Political Economy*, 78(3):456-88.

[29] Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti, (2011), "Growing like China," *American Economic Review,* 101, pp. 202–241.

[30] Tang, Man-Keung, and Shang-Jin Wei, 2009, "The Value of Making Commitments Externally: Evidence from WTO Accessions," *Journal of International Economics*, 78(2): 216-229.

[31] Uribe, Martin, 1997, "Exchange Rate Based Inflation Stabilization: the Initial E ects of Credible Plans," *Journal of Monetary Economics* 39: 197-221.

[32] Uzawa, H., (1968), "Time preference, the consumption function, and optimal asset holdings," in J. N. Wolfe (ed.), Capital and Growth: Papers in Honour of Sir John Hicks, Chicago: Aldine.

[33] Wei, Shang-Jin, and Xiaobo Zhang, 2011, "The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China," *Journal of Political Economy,* June.

# 7 Appendix

## 7.1 Equations for Steady State

Given the factor prices ( ) and the holding of foreign asset , the output, consumption, investment, and aggregate demadn and sectoral output can be determined by the following six equations.

$$- = \overline{=}[\ (1+\ -\ )]^{\frac{1}{\psi}} \tag{7.1}$$

$$= \ + - + \frac{b}{2}\ ^{2} \tag{7.2}$$

$$= \ _{1}\ _{1} + \ _{2}\ _{2} \tag{7.3}$$

$$_{1}\ _{1}\ _{1} + \ _{2}\ _{2}\ _{2} = \ - \tag{7.4}$$

$$(1-\ _{1})\ _{1}\ _{1} + (1-\ _{2})\ _{2}\ _{2} = \tag{7.5}$$

$$_{1}\ _{1} + \ _{2}\ _{2}\ (1+\ ) + \ ^{*}\ = \tag{7.6}$$

where $= \ + (1-\ )\ (1+\ )$.

## 7.2 Equilibrium Selection in the Initial Steady State

In the initial steady state, we assume an exogenous export share, and an import share, to select the equilibrium. Let

$$= \frac{1}{_{1}\ _{1} + \ _{2}\ _{2}} \quad 0$$

$$= \frac{2}{_{1}\ _{1} + \ _{2}\ _{2}} \quad 0$$

Since is initially zero, using expressions of sectoral output, we have

$$_1 \quad + \quad _2 \quad _2 = \frac{(\ _2 - \ _1)(1 + \ ) \qquad -}{(1 - \ _1) - (1 + \ )(1 - \ _2)}$$

Using the expressions for $_1$ and $_1$, we have

$$= \frac{- \qquad [(1 - \ _2)(1 + \ ) \ + \ ((1 - \ _1) - (1 + \ )(1 - \ _2))]}{(\ _2 - \ _1)(1 + \ ) \qquad -}$$

This implies that given the initial share of export , we can determine the initial ratio of wage income to final good expenditure as below

$$\frac{}{} = \frac{(\ _2 - \ _1)(1 + \ ) \ + (1 - \ _2)(1 + \ ) \ + \ ((1 - \ _1) - (1 + \ )(1 - \ _2))}{1 +}$$

Let $= \frac{wL}{PD}$. We can solve for the initial output $\bar{}$ as

$$\bar{} = \frac{}{} \frac{(\ _2 - \ _1)(1 + \ ) \quad ^{-1} -}{(1 - \ _1) - (1 + \ )(1 - \ _2)}$$

In initial steady state, the consumption is given by $= \quad - \frac{I}{P}$, and the investment is given by $= \quad = \frac{\delta}{r}(\ _1 \ _1 \ _1 + \ _2 \ _2 \ _2)$. From the determination of sectoral output, we have

$$= - \frac{(1 + \ )(\ _2 - \ _1) \qquad - (1 + \ )(\ _2 - \ _1)^{*} \quad - (\ _2(1 + \ ) - \ _1)}{(1 - \ _1) - (1 - \ _2)(1 + \ )}$$

For simplicity, we rewrite it as

$$\bar{} = \qquad + \Phi$$

where

$$= \quad - \frac{(1 + \ )(\ _2 - \ _1)}{(1 - \ _1) - (1 - \ _2)(1 + \ )} \qquad 0$$

$$\Phi \quad = \quad - \frac{}{} \frac{(1 + \ )(\ _2 - \ _1)^{*} \quad + (\ _2(1 + \ ) - \ _1)}{(1 - \ _1) - (1 - \ _2)(1 + \ )}$$

Note that $\Phi$ is an investment component determined by the supply side. Therefore, substituting them into the aggregate demand equation, the initial consumption can be expressed as

$$\bar{\ } = \quad [(1 - \quad) - \frac{\Phi}{\ }]$$

where

$$\frac{\Phi}{\ } = - - \frac{{}_2(1 + \quad) - \quad {}_1}{(1 - \quad {}_1) - (1 - \quad {}_2)(1 + \quad)} \frac{\ }{\ }$$

Finally, we obtain the initial consumption as below:

$$\bar{\ } = \frac{\ }{\ }[\frac{1 - \quad}{\ } + - \frac{{}_2(1 + \quad) - \quad {}_1}{(1 - \quad {}_1) - (1 - \quad {}_2)(1 + \quad)}]$$

2

### 7.3 Steady State Equilibrium with Credit Constraint

$$= \frac{1}{{}_b} \frac{{}^* - \quad {}^C +}{1 + \quad {}^C -} \tag{7.7}$$

2

$$(\frac{\ }{{}_1})^{1-\alpha_1} \quad {}_1^{\alpha_1} = \quad {}_1^* {}_2$$

$$_1 \quad _1 = \tag{7.17}$$

$$_2 \quad _2 = (1 - \quad ) \tag{7.18}$$

$$= \quad + \frac{(\quad _1 + \quad _2)}{} + \frac{b}{2} \quad _2 \tag{7.19}$$

$$_1 \quad _1 + \quad _2 \quad _2 \ (1 + \quad ) + \quad ^* \quad = \tag{7.20}$$

$$- = \overline{=}[\ \ (1 + \quad ^C - \quad )]^{\frac{1}{\psi}} \tag{7.21}$$

**Figure 1 (Figure 1 in Caballero, Farhi, and Gourinchas, 2008)**

Figure 1. Current Account Balances, 1990–2008

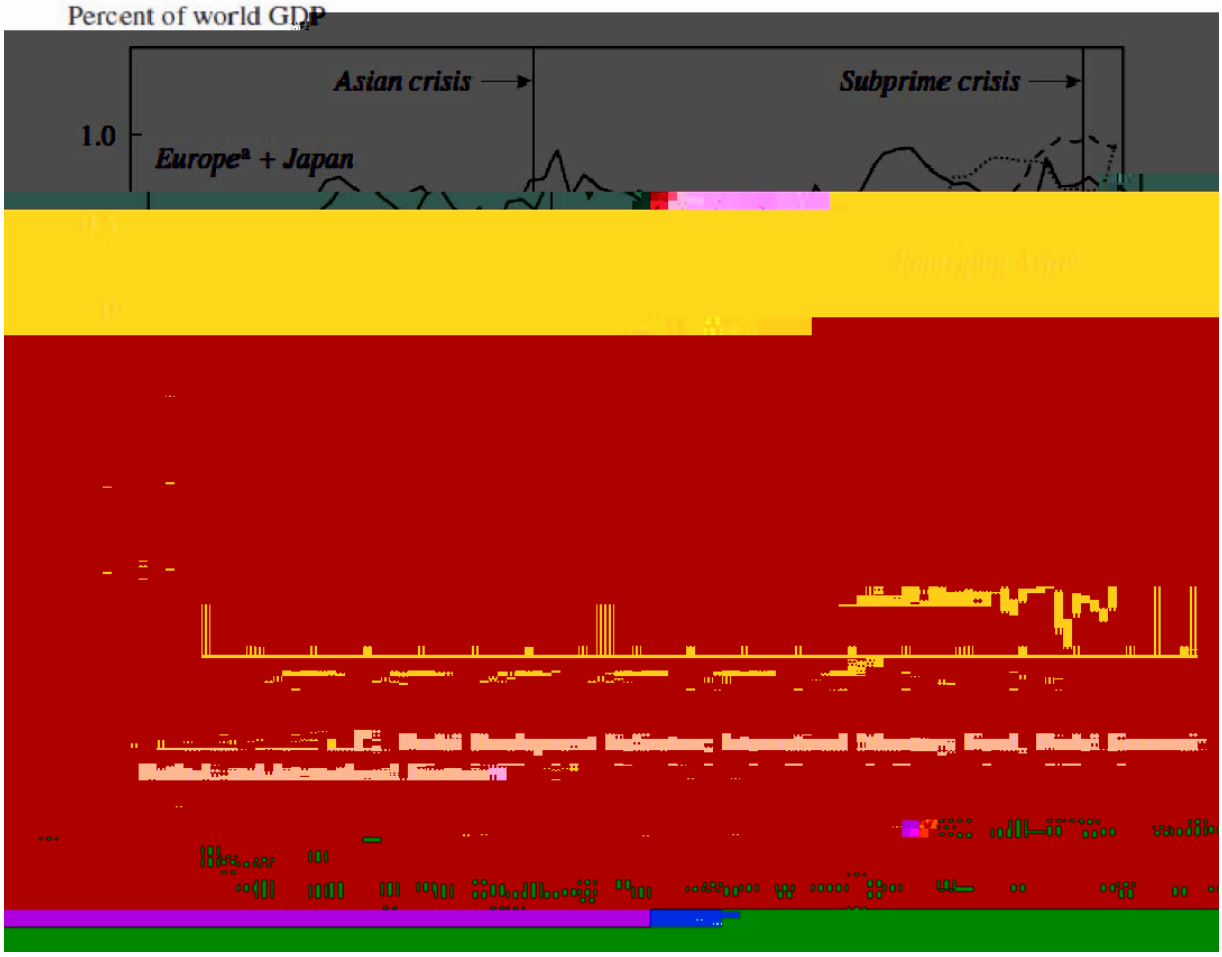
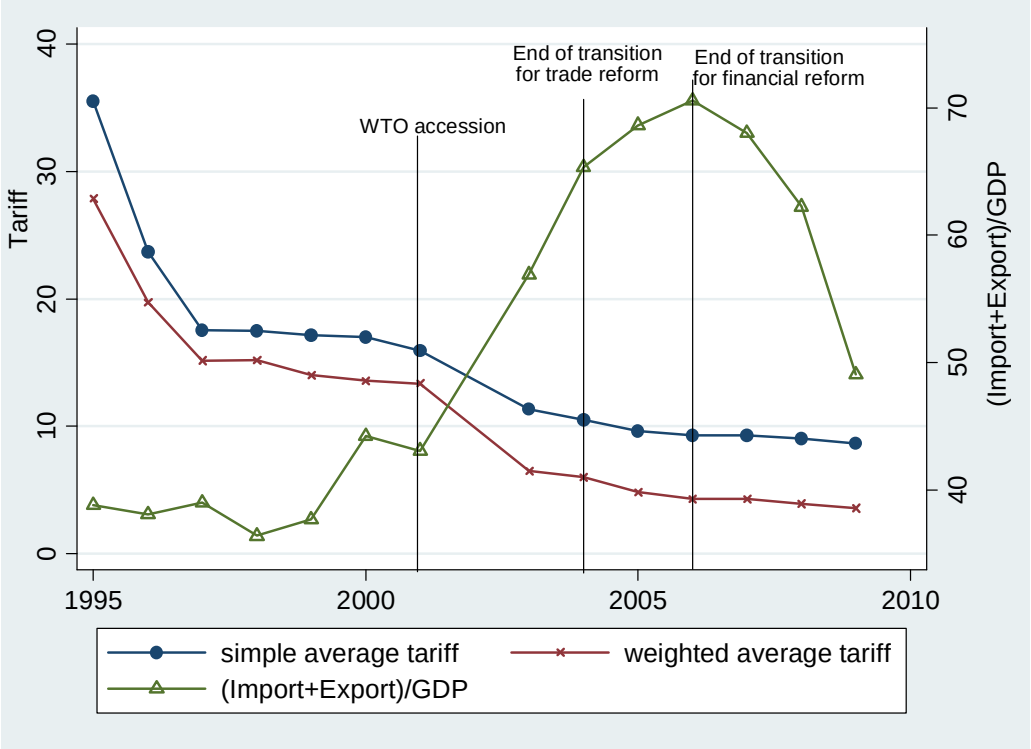
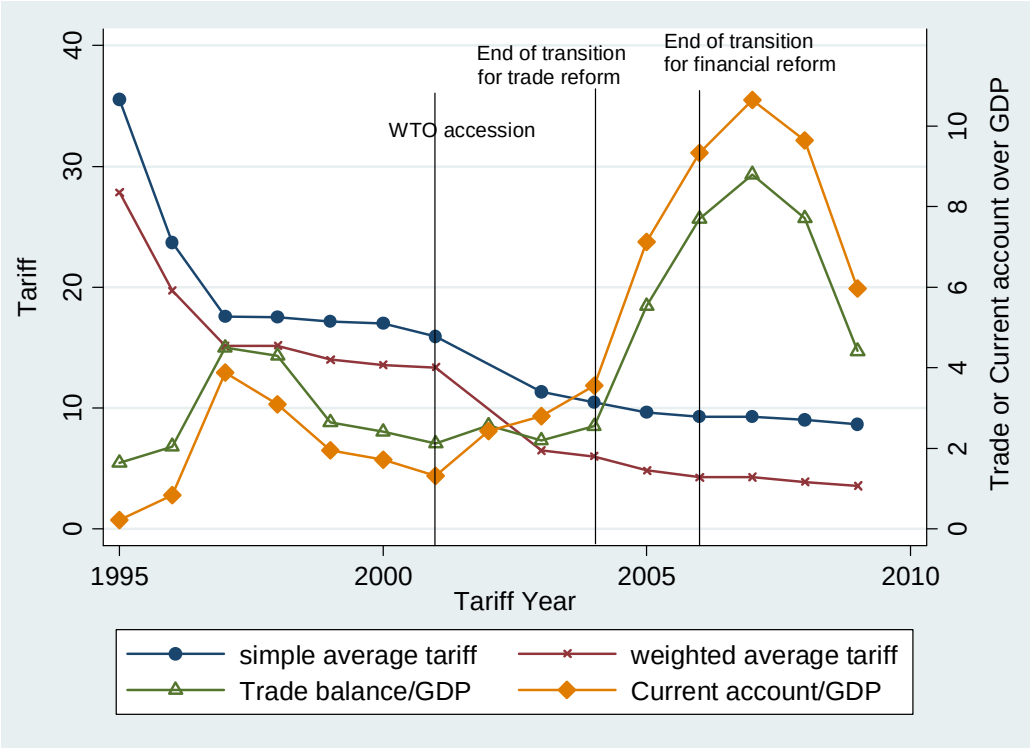


Figure 2: Change of tariffs and trade/GDP for China from 1995-2009, in percentage




Source: WITS and World bank database.

Figure 3: Tariff change, Trade balance/GDP, Current account balance/GDP for China from 1995-2009




Source: WITS and World bank database

Figure 4: Transition path of the economy after trade liberalization ( 5% tariff reduction)

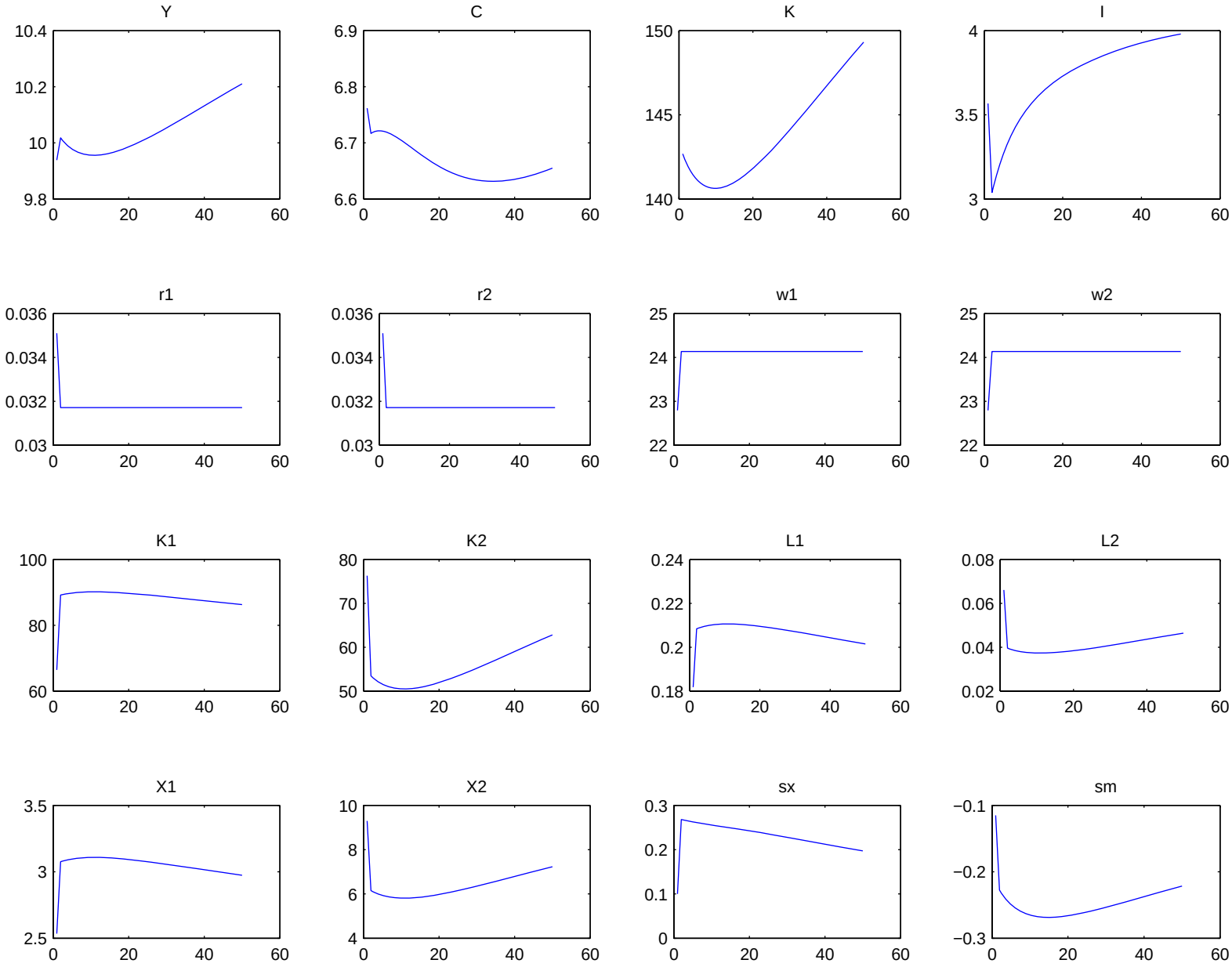


Figure 5: Response of trade and capital flow to trade liberalization ( 5% tariff reduction)

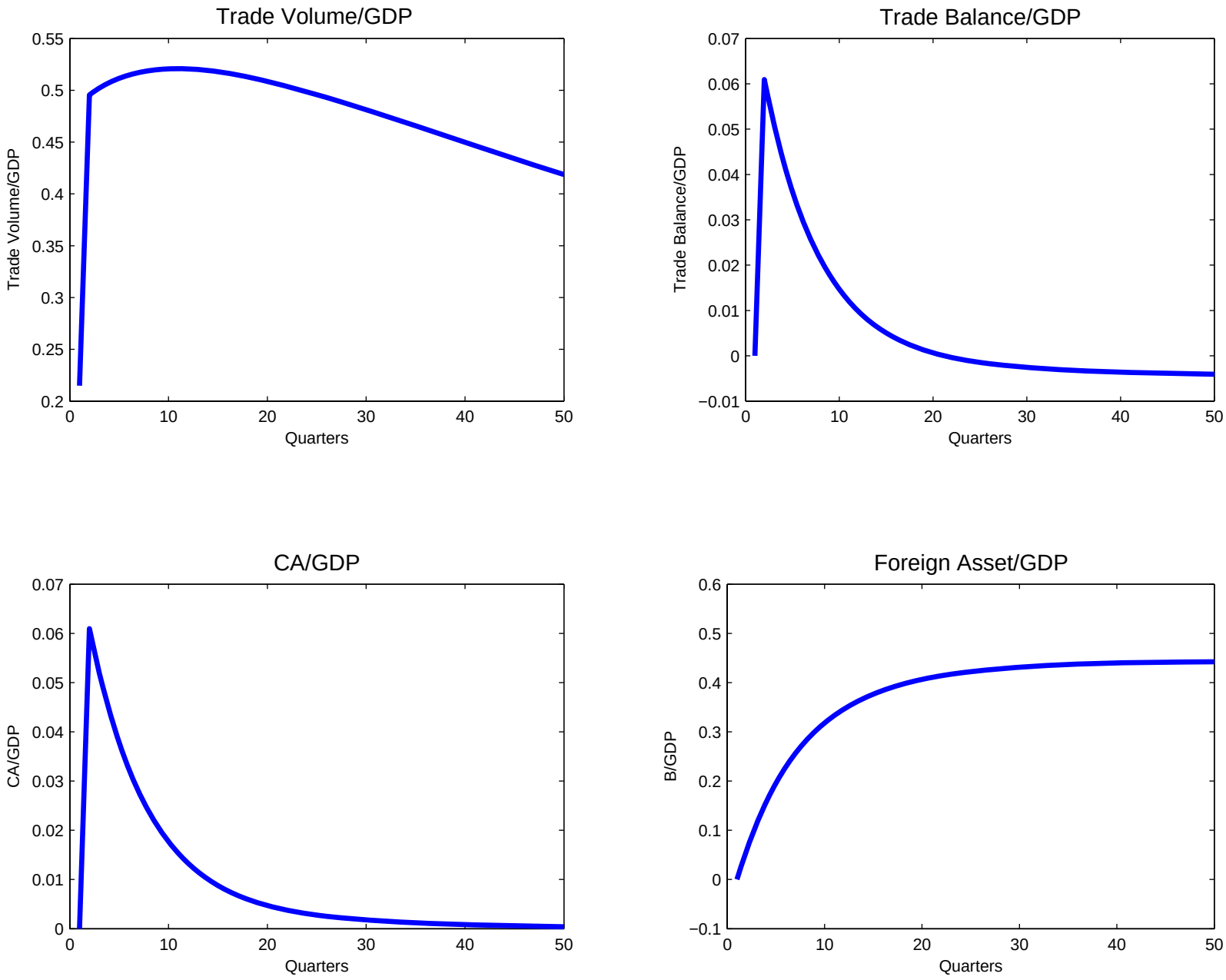


Figure 6: Transition path changes of trade and capital flow

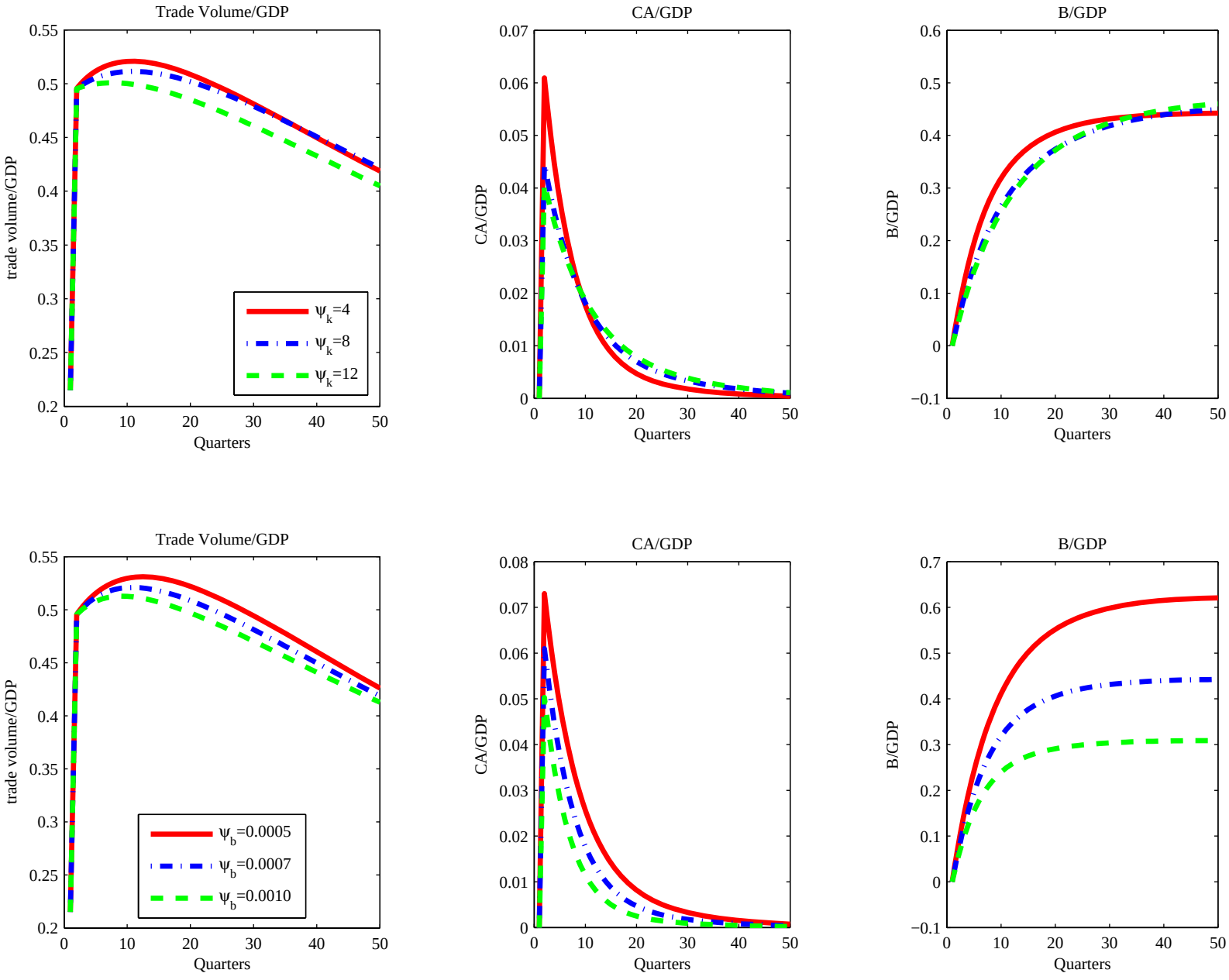


Figure 7: Transition path of the economy after trade liberalization with credit constraint

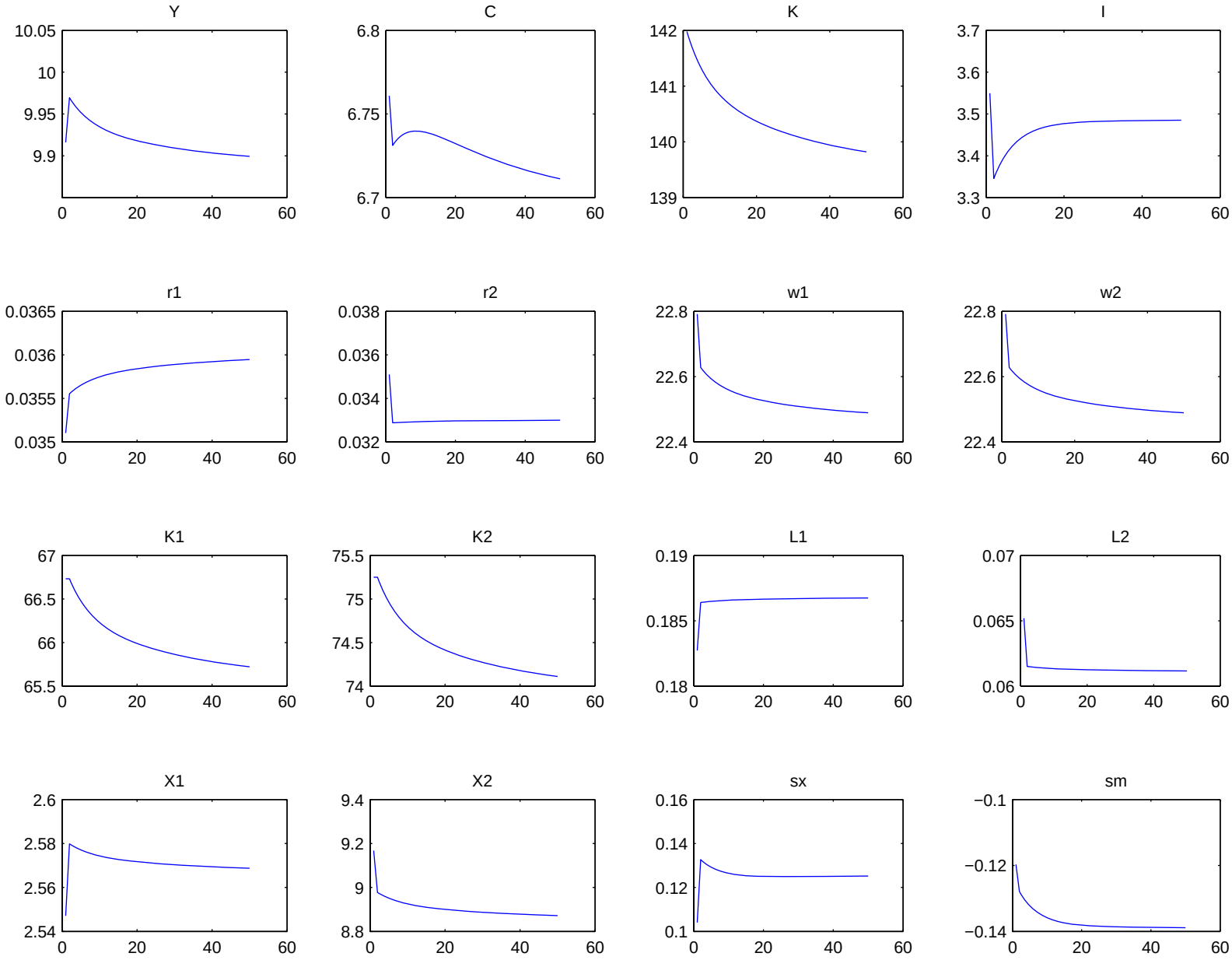


Figure 8: Response of trade and capital flow to trade liberalization with and without credit contraint

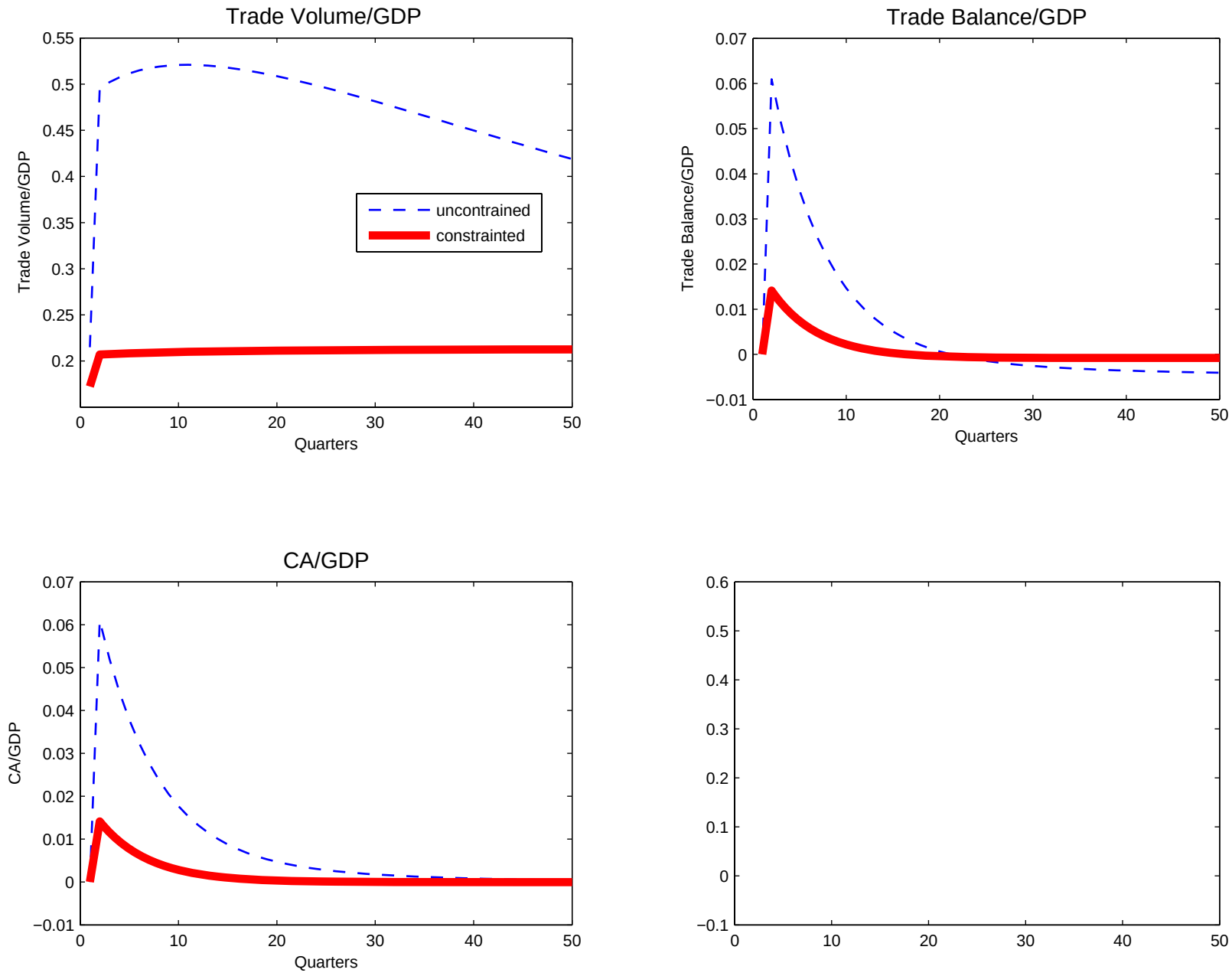
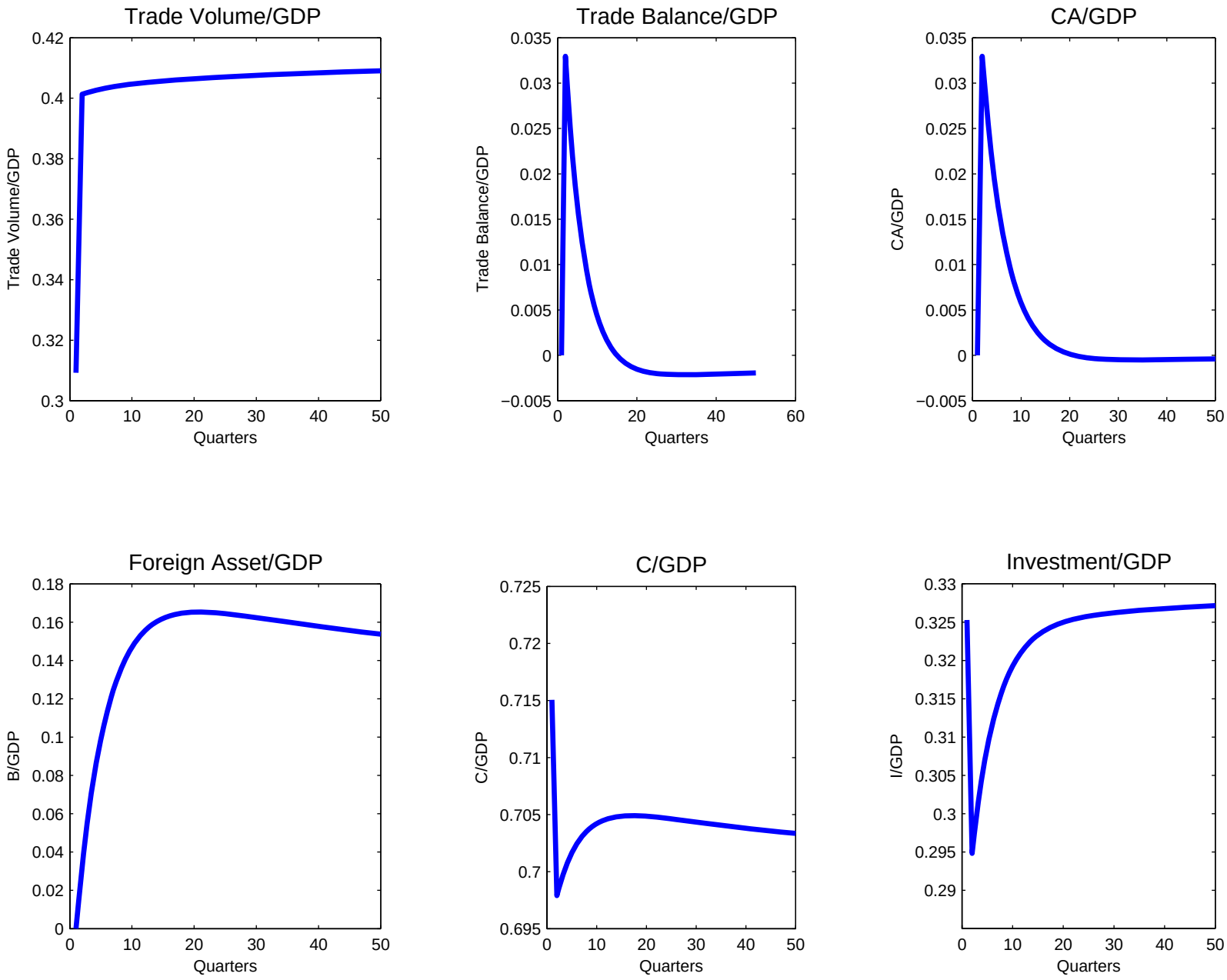
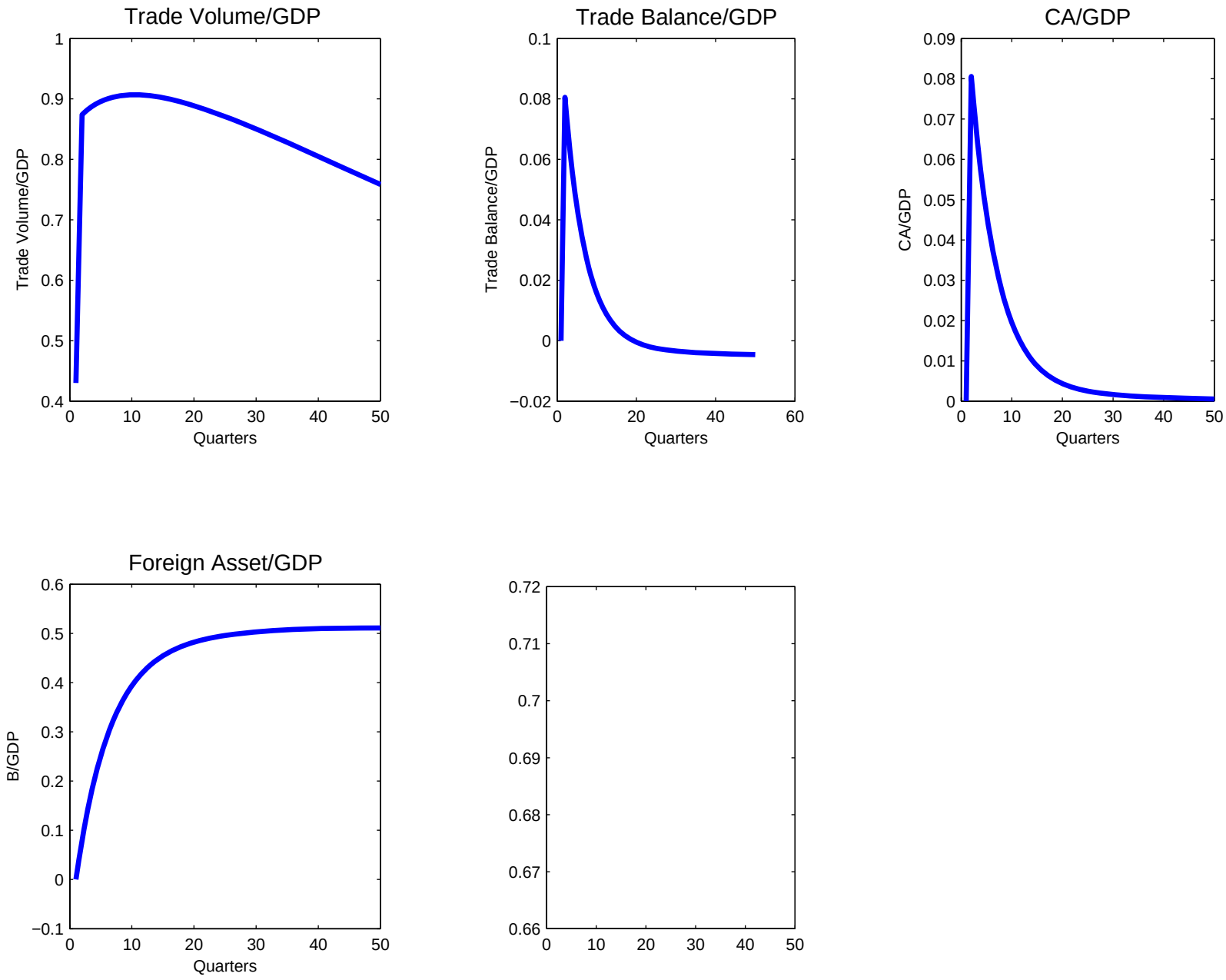


Figure 9: Response of Chinese economy to trade liberalization in 1995 (15% tariff reduction)




Trade Volume/GDP
Trade Volume/GDP
Quarters
Trade Balance/GDP
Trade Balance/GDP
Quarters
CA/GDP
CA/GDP
Quarters
Foreign Asset/GDP
B/GDP
Quarters

| | benchmark | | Credit Constraint | |
|---|---|---|---|---|
| **variable** | tariff=0.15 | tariff=0.1 | tariff=0.15 | tariff=0.1 |
| **rc** | 0.035101 | 0.03171 | 0.035101 | 0.034412 |
| **r1** | 0.035101 | 0.03171 | 0.035101 | 0.035996 |
| **r2** | 0.035101 | 0.03171 | 0.035101 | 0.033008 |
| **w1** | 22.791 | 24.132 | 22.791 | 22.471 |
| **w2** | 22.791 | 24.132 | 22.791 | 22.471 |
| **p1** | 2.5545 | 2.5545 | 2.5545 | 2.5545 |
| **p2** | 0.45018 | 0.43061 | 0.45018 | 0.43061 |
| **p** | 1.0724 | 1.0488 | 1.0724 | 1.0488 |
| **c** | 6.7617 | 6.9124 | 6.7608 | 6.6973 |
| **d** | 10.088 | 10.707 | 10.071 | 10.024 |
| **b** | 0 | 4.5883 | 2.68E-18 | 0.92928 |
| **k** | 142.68 | 158.9 | 141.98 | 139.55 |
| **l** | 3.567 | 3.9724 | 3.5496 | 3.4888 |
| **k1** | 66.409 | 81.692 | 66.732 | 65.589 |
| **k2** | 76.273 | 77.203 | 75.251 | 73.962 |
| **l1** | 0.18182 | 0.19084 | 0.18271 | 0.18679 |
| **l2** | 0.066076 | 0.057064 | 0.06519 | 0.061112 |
| **x1** | 2.5347 | 2.8168 | 2.5471 | 2.5673 |
| **x2** | 9.2923 | 8.8831 | 9.1678 | 8.8586 |
| **d1** | 2.1174 | 2.198 | 2.1138 | 2.0578 |
| **d2** | 12.015 | 13.04 | 11.995 | 12.207 |
| **nx1** | 1.066 | 1.5807 | 1.1067 | 1.3016 |
| **nx2** | -1.2259 | -1.7898 | -1.2727 | -1.4421 |
| **ca** | 0 | 0 | 0 | 0 |
| **sx** | 0.10001 | 0.14343 | 0.10407 | 0.12548 |
| **sm** | -0.11501 | -0.1624 | -0.11969 | -0.13902 |
| **debt/gdp ratio** | 0.0% | 41.6% | **0.0%** | **9.0%** |
| **trade volume/GDP** | 21.5% | 30.6% | **22.4%** | **26.5%** |
| **GDP** | 9.938547896 | 10.50788262 | **9.915821665** | **9.890131194** |
| **consumption** | 6.7617 | 6.9124 | **6.7608** | **6.6973** |
| **c/y** | 68.0% | 65.8% | **68.2%** | **67.7%** |
| **i/py** | 33.5% | 36.0% | **33.4%** | **33.6%** |

| | 1990s China | | WTO Accession | |
|---|---|---|---|---|
| **variable** | **tariff=0.30** | **tariff=0.15** | tariff=0.15 | tariff=0.07 |
| **rc** | 0.035101 | 0.033655 | 0.035101 | 0.029768 |
| **r1** | 0.035101 | 0.03747 | 0.035101 | 0.029768 |
| **r2** | 0.035101 | 0.029587 | 0.035101 | 0.029768 |
| **w1** | 22.791 | 21.969 | 22.791 | 25.005 |
| **w2** | 22.791 | 21.969 | 22.791 | 25.005 |
| **p1** | 2.5545 | 2.5545 | 2.5545 | 2.5545 |
| **p2** | 0.5089 | 0.45018 | 0.45018 | 0.41886 |
| **p** | 1.1402 | 1.0724 | 1.0724 | 1.0344 |
| **c** | 6.522 | 6.3888 | 6.7411 | 6.9275 |
| **d** | 9.4889 | 9.3822 | 9.6871 | 10.619 |
| **b** | -1.29E-21 | 1.3373 | 0 | 5.1315 |
| **k** | 135.31 | 128.36 | 126.37 | 152.18 |
| **l** | 3.3828 | 3.2091 | 3.1592 | 3.8044 |
| **k1** | 69.82 | 66.236 | 73.959 | 100.92 |
| **k2** | 65.49 | 62.129 | 52.409 | 51.261 |
| **l1** | 0.19117 | 0.20084 | 0.2025 | 0.21357 |
| **l2** | 0.056735 | 0.047065 | 0.045403 | 0.034326 |
| **x1** | 2.6649 | 2.6988 | 2.8229 | 3.2666 |
| **x2** | 7.058 | 6.38 | 6.385 | 5.6922 |
| **d1** | 2.1176 | 1.9693 | 2.0333 | 2.1499 |
| **d2** | 10.63 | 11.175 | 11.538 | 13.112 |
| **nx1** | 1.3982 | 1.8634 | 2.0171 | 2.8526 |
| **nx2** | -1.8176 | -2.1585 | -2.3197 | -3.1077 |
| **ca** | 0 | 0 | 0 | 0 |
| **sx** | 0.13445 | 0.1908 | 0.2 | 0.26588 |
| **sm** | -0.17478 | -0.22101 | -0.23 | -0.28966 |
| **debt/gdp ratio** | **0.0%** | **13.7%** | 0.0% | 47.8% |
| **trade volume/GDP** | **30.9%** | **41.2%** | 43.0% | 55.6% |
| **GDP** | **9.12059573** | **9.10689388** | 9.40460402 | 10.37196886 |
| **consumption** | **6.5220** | **6.3888** | 6.7411 | 6.9275 |
| **c/y** | **71.5%** | **70.2%** | 71.7% | 66.8% |
| **i/py** | **32.5%** | **32.9%** | 31.3% | 35.5% |

Table A1: Tariff Reductions, Trade Volume and Current Account in China

| year | simple average tariff | weighted average tariff | (import+export) /GDP | (export-import)/GDP | Current account/GDP |
|---|---|---|---|---|---|
| 1995 | 0.3552 | 0.2786 | 0.3881 | 1.6426 | 0.2223 |
| 1996 | 0.2370 | 0.1972 | 0.3806 | 2.0502 | 0.8461 |
| 1997 | 0.1756 | 0.1515 | 0.3901 | 4.4951 | 3.8800 |
| 1998 | 0.1750 | 0.1517 | 0.3639 | 4.2999 | 3.0871 |
| 1999 | 0.1716 | 0.1401 | 0.3769 | 2.6491 | 1.9492 |
| 2000 | 0.1701 | 0.1357 | 0.4424 | 2.4092 | 1.7120 |
| 2001 | 0.1592 | 0.1336 | 0.4308 | 2.1199 | 1.3135 |
| 2002 | 0.0000 | 0.0000 | 0.0000 | 2.5713 | 2.4365 |
| 2003 | 0.1133 | 0.0648 | 0.5691 | 2.1987 | 2.7956 |
| 2004 | 0.1048 | 0.0600 | 0.6535 | 2.5514 | 3.5544 |
| 2005 | 0.0964 | 0.0483 | 0.6863 | 5.5296 | 7.1256 |
| 2006 | 0.0929 | 0.0428 | 0.7057 | 7.7006 | 9.3355 |
| 2007 | 0.0929 | 0.0429 | 0.6803 | 8.8000 | 10.6419 |
| 2008 | 0.0902 | 0.0390 | 0.6224 | 7.7152 | 9.6445 |
| 2009 | 0.0866 | 0.0357 | 0.4907 | 4.4148 | 5.9602 |