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ABSTRACT

Permanent shocks such as trade liberalizations are hard to discuss in a standard dynamic Hechscher-Ohlin model due to potential interest rate over-determination. We make three contributions. First, we introduce an endogenous discount factor which solves the problem of interest rate over-determination. Second, we show that trade liberalization in a developing country generally leads to capital outflow, whereas it produces an opposite pattern for developed countries. Therefore, efficient trade reforms can contribute to global current account imbalances. Third, following a trade reform, the current account imbalance first widens and then falls back to zero. As an application, this model predicts an inverse-V-shape pattern for current account imbalances following China's accession to the WTO: Even without policy distortions, China's current account imbalance should rise for a few years before it starts to shrink.

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1 Introduction

How does a reduction in trade costs such as a unilateral tariff reduction by the importing country affects its current account? If the lower costs of importing translate into more imports, one is tempted to conclude that the importing country's current account should deteriorate (i.e. generating either a bigger deficit or a smaller surplus). This is a partial equilibrium intuition. In this paper, we argue that the general equilibrium effect can often have an opposite sign from a partial equilibrium effect, especially for developing countries.

In media and policy discussions, it is often assumed that a country's restrictions on imports contribute to its current account surplus. Think of the numerous reports on China's and Mexico's import restrictions and their supposed impact on its current account surplus. Indeed, the US government routinely blames China's import restriction as a contributing factor to China's trade surplus against the United States. Similarly, it is commonly assumed that, when a country liberalizes trade (i.e., reducing trade barriers on imports), its trade balance would decline. One key message of the current paper is that such an assertion is not correct. To the best of our knowledge, this is the first paper that demonstrates the pitfalls of the conventional view in a dynamic general equilibrium model. Indeed, we will show that, for a typical developing country, reducing import barriers can be expected to improve (rather than worsen) its current account. To accomplish this, we propose a dynamic Heckscher-Ohlin framework, with a necessary modification of the standard setup to overcome the challenge of interest rate over-determination - to be explained below - and enable it to study permanent shocks such as a permanent tariff cut. Our empirical work suggests that the data patterns are consistent with the key theoretical predictions.

National trade barriers tend to be placed on products in which the country in question does not have a comparative advantage. For a typical developing (labor abundant) country, trade barriers are likely to be disproportionately on capital intensive goods. A reduction in the import barriers on the capital-intensive good reduces the domestic return to capital, all else equal. This is the intuition one obtains from the Stolper-Samuelson theorem in the static trade theory. If the pre-liberation return to capital was equal to the world interest rate (after adjusting for risk premium and transaction costs), the import liberalization upsets the equilibrium, by reducing the returns to the relatively scarce factor (i.e., capital) and thus rendering the domestic interest rate to be lower than its international counterpart. To restore the equilibrium, the country must export enough capital, i.e., running a current account surplus.

Trade liberalizations would generally induce an opposite current account response in a rich (or capital abundant) country. Reductions in trade barriers (of the labor intensive good) in such a country should raise the return to capital by the logic of the Stolper-Samuelson theorem. As a result, the country would attract capital inflow, i.e., creating a current account deficit.

The paper aims to make three contributions. The first is methodological in nature. Existing dynamic Hecksher-Ohlin models are not suitable for studying permanent shocks or structural changes such as trade liberalization due to a potential problem with interest rate over-determination. To solve the problem, we propose to incorporate an endogenous discount factor. Second, we show that the Stolper-Samuelson theorem holds in our dynamic model and this mechanism produces the general equilibrium effect of the current account described above. Third, the model naturally rationalizes what we observe in the data - China first experiences a rise in its current account surplus as a share of GDP (up to 2007) and then a gradual decline (an inverse-V-pattern). Let us explain the three contributions in turn.

To understand the first contribution, we highlight an interest rate over-determination problem. On the one hand, in a static Heckscher-Ohlin model, if the economy is within the diversification cone, the interest rate is determined by the zero profit conditions from the supply side. That is, the interest rate, together with the wage, is completely determined by goods prices. Preference parameters such as the time discount factor play no role. On the other hand, in a standard intertemporal model, the interest rate in the steady state is determined by the time discount factor from the demand side. When the two models are merged, the two interest rates from the two approaches would not be the same in general except by coincidence. Even assuming that the two are the same initially, any permanent shock such as trade liberalization would cause the two to diverge again. This problem has been raised by Stiglitz (1970) when he shows that, in a dynamic HO model, unless the two countries have identical discount factors, one country must specialize. As specialization does not appear to describe the real world well, and in any case it is hard to discuss structural changes in a model with complete specialization, it is desirable to have an intertemporal model with a HO structure that overcomes the problem of interest rate over-determination.

Our solution is to introduce an endogenous discount factor. In that case, the interest rate is determined by the zero profit conditions as in the static HO model. With an endogenous discount factor, the total consumption in the steady state would simply adjust to conform with the interest rate, avoiding over-determination or inconsistency. With such a modification, the effect of trade reforms on current accounts can be analyzed.

An endogenous discount rate is a discount rate that varies over time, for example, as a function of the economy-wide consumption per capital and income per capita. An individual may become more impatient if her own consumption level falls behind the average level in the economy, or her own past consumption. In other words, people pay attention to status competition, where status is defined either by one's consumption relative an economy-wide average or by one's own past consumption. An endogenous discount factor is not just a technical convenience, but, at a philosophical level, can also be regarded as capturing human nature. Once we recognize this feature (and represent it in the utility function), we can resolve some seemingly puzzling features in models that impose a constant subjective discount rate.

To understand the second contribution - deriving a version of the Stolper-Samulson theorem in our dynamic model, it is useful to note that such a theorem has not been previously proven in part because the interest rate over-determination problem has not been tackled before. The new Stolper-Samuelson theorem provides a mechanism for the current account to react in a seemingly counter-intuitive way following a permanent shock.

The third contribution is an application of our framework to understand the rise and fall of current account surplus in China in recent years. China's accession to the World Trade Organization at the end of 2001 (with massive cuts in the country's tariffs and, importantly, non-tariff import barriers) was a watershed event for both China and the rest of the world. Our model can be used to study the current account dynamics of this event. The model predicts that China would generate a current account surplus following the WTO accession. Because many trade reform measures were implemented in a phased manner, the current account surplus would rise for a number of years. Interestingly, the same model also predicts that the current account surplus would eventually shrink. This is because the economy will eventually converge to a new steady state in which the net foreign asset remains a constant, and the current account balance will also converge to zero after the trade reform. Our third contribution, therefore, is to predict an inverse-V-shape of current account dynamics.

This inverse-V-shape theoretical prediction is broadly consistent with the data. Figure 1 traces out the trajectory of China's trade-weighted average tariff rate from 1998 to 2010. The average tariff rate was as high as 14% before 2001 (with tariff rates on many capital-intensive goods in excess of 50%) but declined in phases to a more modest 5% by 2004 and stayed that low afterwards. Consistent with our theoretical model, China's current account surplus (at 2% of GDP) was very mild in the year before China joined the WTO, but started to rise noticeably afterwards until 2007 when it began to fall. The standard explanation blames the Chinese exchange rate policy for the initial rise, and the contraction of trade volume triggered by the global financial crisis for the decline in the current account imbalance since 2008. Our model suggests another contributing factor at play - the same initial shock of China's WTO accession can simultaneously generate the initial rise in the imbalance and the subsequent fall.

It is useful to note that the US import barriers also came down in two quantitatively important way. First, the US quotas on textile and garment imports from China had to be eliminated in two phases: the first batch on December 12, 2001, when China joined the WTO (and the early rounds of quota elimination under the auspices of the WTO became applicable to China immediately), and the remaining batch on January 1, 2005. (See Khandelwal, Schott, and Wei, 2013, for additional details). Second, the US granting of permanent normal trading relationship (PNTR) to China in October 2000 removed a major uncertainty on future tariffs that could be applied to Chinese imports. Without the PNTR, there is always a chance that the United States could switch to the so-called "Column 2" tariffs, which are essentially the very high Smoot-Hawley tariff rates set in the 1930s.

By exploring variations in the difference between the Column 2 tariff and the PNTR tariffs (which the US gives to most other trading nations) across industries, Pierce and Schott (2016) show that this policy change has a very large explanatory power for understanding the rapid rise of Chinese exports to the US and a sharp decline in the US manufacturing sector employment. Handley and Limao (2017) develop a theoretical model to infer that the PNTR is equivalent to a permanent cut in the US tariff rate by 13 percentage points (on mostly labor-intensive products). Feng et al (2014) report that the PNTR has had a noticeable effect on the prices and quality of goods exported by the Chinese firms to the United States. Because the US trade protection was heavily geared towards labor intensive sectors, the PNTR reform is disproportionately more important for the imports of labor intensive products. The upshot is that at the beginning of this century, the United States also engaged in a trade reform, albeit in a non-traditional way. Because the United States is a capital abundant country, our model predicts that its trade reform tends to lead to a larger current account deficit.

In sum, our theory suggests that trade liberalizations in both China and the United States in 2005 may have played a role in both the initial rise in the current account imbalances and the subsequent fall. By this perspective, instead of being driven by underlying distortions in an economy, current account imbalances can arise as an equilibrium response to welfare-improving trade reforms. Therefore, not all current account imbalances need policy corrections.

Reforms in factor markets can also influence how trade reforms affect current account. This has important practical implications as countries sometimes pursue factor market reforms in conjunction with trade liberalization. For example, in the case of China's accession to the WTO, the country has agreed to a set of policies to reform its financial market, including increased openness to direct investment by foreign banks and other financial institutions over several phrases, in addition to reducing import barriers. The last part of the paper explores the consequences of factor market reforms for the current account response to trade reforms. We show that, with financial market reforms, a given amount of tariff cut generates a bigger current account surplus. This theoretical result helps us to understand why the Chinese trade reform in the early 2000s produces a bigger current account response than the reforms in the 1980s and 1990s.

The paper is organized as follows. Section 2 provides a literature review. Section 3 reports some suggestive empirical patterns. After a basic model is presented in Section 4, the effects of trade reforms on the current account and other macroeconomic variables are derived in Section 5. The interactions between factor market flexibility and trade reforms are discussed in Section 6. Finally, concluding remarks are offered in Section 7.

2 Literature Review

We explain the contributions of the current paper by placing it in the literature that extends models of international trade into studies of current account. Based on Ricardian comparative advantage, Eaton et al. (2016) and Reyes-Heroles (2015) extend the static Eaton and Kortum model (2002) to a dynamic setup. The former studies the trade collapse during the Great Recession where trade imbalances arise from the solution to a planner's problem, while the latter considers the role of trade costs on trade imbalances.[1] Unlike our paper, these models feature a single factor of production and do not consider changes in the composition of tradable sectors (with different factor intensities) as a channel of adjustment. The intuition for how a trade cost reduction affects current account imbalances is related to the classic paper by Obstfeld and Rogoff (2000) in which the trade cost acts as a tax on the intertemporal trade (capital flows).

Note that the form of trade costs is important. For example, Alessandria, Choi and Lu (2016) study the effects of China's accession to WTO on China's current account surplus in a macroeconomic model that embeds a Melitz style heterogeneous firm model. There is a single factor in production and therefore no adjustment in the composition of tradable sectors with different factor intensities. To generate an increase in trade imbalance, the model requires China's trading partners (not China itself) to reduce trade costs (which reduces the fixed entry costs for foreign firms to export to these markets), and also a symmetric reduction in variable trading costs (think of variable cost of transportation) for both Chinese and partners' exports. The calibration results are consistent with the conventional wisdom: if China's trading partners reduce import barriers more than China does, China's trade surplus goes up. However, the actual evolution of trade costs are different from this path. China's WTO accession in 2001 required China to unilaterally

[1] Reyes-Heroles (2015) calibrates the model and shows that 69% of the increase in world trade imbalances can be explained by sysmetric decline in trade costs across countries.

reduce the costs of imports from foreign partners, while its partner countries did not need to liberalize. (Except for the PNTR reform by the United States, other countries do not need to reduce their trade barriers to satisfy China's WTO membership. Even in the case of the United States, the reduction in trade barriers is smaller than the reduction in Chinese trade barriers on capital intensive goods.) This seems to run counter the assumptions of the model. In Reyes-Heroles (2015), whether a country runs a surplus or a deficit is not determined by changes in trade costs per se, but by the initial position of the current account.

The empirical relationship between trade reforms and current account has been examined by Ostry and Rose (1992) and Ju, Wu, and Zeng (2010). They find the relationship to be ambiguous. But these papers do not examine interactions between a country's factor endowment pattern and trade reforms. Our theoretical model provides an explanation for this ambiguity as it shows that the effects of a trade reform on the current account depend on whether a country is relatively labor abundant and whether the pre-liberalization protection is mostly on capital intensive goods.

Our paper is related to a small but growing literature that studies international capital flows in dynamic HO models. These papers include Cunat and Maffezzoli (2004), Ju and Wei (2007), and Ju, Shi and Wei (2014). Cunat and Maffezzoli (2004) develop a two-country model with Heckshser-Ohlin structure to study the correlation between the terms of trade and output. In their model, trade is balanced by assumption and hence there is no interesting current account dynamics. Ju and Wei (2007) and Ju, Shi and Wei (2014) investigate how the domestic labor market affect the current account dynamics in a dynamic Hecksher-Ohlin framework. However, these papers do not address the interest rate over-determination problem and do not study tariff changes or other permanent shocks that can alter the interest rate.

Jin (2012) is another important contribution that builds a two-country two-sector overlapping-generations model. There are a few significant differences between her and our models. First, factors are sector specific in her model (capital can flow between countries but not between sectors within a country). Due to differences in the factor intensity of the two sectors, trade openness leads capital to flow towards countries that become more specialized in capital-intensive industries. In comparison, we allow for capital reallocation between sectors. As shown in Antras and Caballero (2009), specific-factor models yield an "anti Stopler-Samuelson theorem," and, as a result, trade and capital movements are complements. In comparison, the Stolper-Samuelson theorem holds in our model and trade and capital flows are substitutes. Second, while her paper does not discuss interest rate over-determination, we address this problem head on.

This paper is related to several papers on the cause of global current account imbalances. Caballero, Farhi, and Gourinchas (2008) and Mendoza, Quadrini, and Rios-Rull (2009) highlight the role of differences in financial development between current account surplus and deficit countries. Countries with a relatively weak financial development (e.g., China) cannot produce enough financial assets at home to absorb all the savings. As a result, they export part of their savings to countries with better financial development (e.g., the United States). As a result, countries such as China run a current account surplus, and countries such as the United States run a deficit. Song, Storesletten and Zilibotti (2011) also feature financial sector imperfections in China in generating a current account surplus. It stresses the inability of productive domestic private sector firms to borrow from the formal financial sector as a key friction. These firms have to save to finance their investment. As the share of these firms grows in the economy, so does the country's current account surplus. In these papers, when China's financial market develops (including improvement in access to finance by private firms), the country's current account surplus would decline rather than increase. In contrast, our theory in this paper will suggest that factor market reforms such as improvements in the financial market will reinforce the effect of trade liberalization on the current account, i.e., making the surplus even bigger than without the improvement in the financial sector. On the other hand, our model predicts that, once the trade reform stops, the current account surplus would eventually subside.

3 Some Data Patterns

Before we present a formal model, it is useful to look at more facts beyond the China example. To this end, we examine the current account experience of all countries that have experienced a major trade policy change in the last two decades. More precisely, we adopt a two-step procedure. First, we identify episodes of large trade policy changes for all countries since 1990 (for which the relevant data are available). Second, for each country in the sample, we measure changes in the country's capital intensity and examine its relationship with changes in the country's current account.

We define a trade reform episode as one that simultaneously satisfies two criteria: (a) there is a reduction in the country's average tariff rate (in terms of either the simple-weighted tariff or the trade-weighted tariff) by 3 percentage points or more in one or two years; and (b) there is an increase in the country's imports-to-GDP ratio by 3 percentage points any time in the first, second or the third year after the tariff reduction relative to the ratio in the year before the tariff change. (The second criteria is to ensure that the trade reform is effective, so that the tariff reduction is not offset by increased bureaucratic hurdles or other non-tariff import barriers.)

Some trade reforms may result in a decline in the country's capital intensity in its production, while others may produce an increase in capital intensity. Our theory suggests that the current account consequence of trade reforms may differ in these two cases. We now perform a simple check on whether, following a major trade policy change, the change in a country's current account pattern is systematically related to the change in its capital intensity.

While it is relatively straightforward to measure a change in a country's current account, how do we measure a change in its capital intensity? Our approach is to measure the capital intensity of the country's export structure before and after the trade policy change. (Ideally, we would like to measure the capital intensity of the country's entire production structure, but we do not have as good data on the sector-level production as that on sector-level exports.) We do it in two steps. First, we use the 2002 US Standard Make and Use Tables (from the US Bureau of Economic Analysis) to compute capital intensity of each HS 6-digit sector. Second, for a given country in the sample in any given year, we can compute the average capital intensity of its export bundle based on the shares of each HS 6-digit sector. Our maintained assumption is that the capital intensity of a sector is a technological feature that does not change across countries. (What we actually need is a somewhat weaker assumption: the ranking of sectors in terms of capital intensity, rather than the absolute values of capital intensity, is highly correlated across countries.)

By our filtering criteria, there are 38 episodes, involving 31 distinct countries, that qualify as trade reforms. Unfortunately, 8 of the episodes suffer from missing data on either trade intensity (Bangladesh 2007, Bhutan, Lesotho, Pakistan, Philippines, Syria, Zimbabwe) or current account (Lebanon). Two episodes appear to be obvious outliers (Belize and Guyana) as their changes in trade composition are substantially bigger than other country-episodes. A list of the 38 trade reform episodes is provided in Table 1. A * is affixed to the country episodes if we also have the relevant data on current account and capital intensity that are not obvious outliers. There are 28 country episodes that receive a *.

We present a simple scatter plot in Figure 2 of changes in current account (as a share of GDP) against changes in capital intensity. A negative relationship between the two variables is visible. On average, a trade policy change that leads to a reduction in the capital intensity of the economy tends to be followed by an improvement in the current account balance.

We then perform the following simple regression:

$$\Delta(\frac{CA_j}{GDP_j}) = \alpha + \beta\Delta k_j + \theta X_j + \varepsilon_j \tag{3.1}$$

where $\Delta(\frac{CA_j}{GDP_j})$ and Δk_j represent the change in country j's current account to GDP ratio, and the change in the average capital intensity of its export bundle, respectively, while X_j are other control variables such as the change in the real exchange rate. In Column 1 of Table 2, we report the basic regression result. The regression shows a negative and statistically significant relationship between the change in capital intensity and change in current account. The coefficient of course simply captures the slope of the fitted line in Figure 2. In other words, in episodes in which a trade policy change has led to a decline in the capital intensity of the country's exports (e.g., China after the WTO accession in 2002-2003), the current account balance tends to go up. Conversely, in episodes in which a trade policy change has led to an increase in capital intensity (such as India during 2005-2008), the current account balance tends to deteriorate.

In Column 2, we add the change in a country's real exchange rate over the same period of the trade policy change as a control variable. Because price (or inflation) information is missing for several countries in the sample, the regression sample is greatly reduced to only 13 countries. In any case, the coefficient on the real exchange rate is negative and statistically significant, suggesting that a rise in the real exchange rate tends to be associated with a decline in a country's current account. More importantly, we continue to find a negative coefficient on capital intensity: a rise in a country's capital intensity tends to be associated with a deterioration of its current account.

Because of the small sample size, we are not able to have many control variables. We also do not investigate potential endogeneity of the regressors. We therefore treat the empirical pattern as suggestive rather than definitive. In the rest of the paper, we aim to provide a theory that is consistent with this pattern in the data.

4 The Basic Model

Our model, in a nutshell, marries a Heckscher-Ohlin structure (with two tradable sectors of different factor intensities) and a small open-economy intertemporal framework. Importantly, we also incorporate a version of an endogenous discount factor (EDF) following Uzawa (1968), Obstfeld (1982), Mendoza (1991), Uribe (1997), Schmitt-Grohe (1998), and Choi, Mark, and Sul (2008), among others. The EDF has a built-in "keeping-up-with-the Joneses" feature - an economic agent tends to become more patient when others in the economy are more patient, and vice versa. Philosophically, this strikes us as having captured a realistic feature of the world that is especially relevant when it comes to topics related to savings and consumption.

As noted earlier, the introduction of an endogenous discount factor helps us to address an inherent tension between the static HO trade model and the standard intertemporal framework, which is the problem of interest rate over-determination. 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, if the economy is within the diversification cone, the interest rate is determined by the zero profit conditions from the supply side (i.e., the interest rate and the wage are completely determined by goods prices). In general, the two interest rates are inconsistent with each other except by coincidence. Even assuming the two are the same initially, a permanent shock such as trade liberalization would cause the two implied interest rates to diverge again. With an endogenous discount factor, the problem of interest rate over-determination disappears. For any interest rate that is determined by the zero profit condition, the total consumption adjusts to accommodate that[2].

An endogenous discount rate means a discount rate that varies over time, for example, as a function of the economy-wide consumption per capital and income per capita. An individual may become more impatient if her own consumption level falls behind the average level in the economy, or her own past consumption. In other words, people pay attention to status competition, where status is defined either by one's consumption relative an economy-wide average or by one's own past consumption. It is not just a technical convenience, but at a philosophical level, can also be regarded as capturing human nature. Once we recognize this feature (and represent it in the utility function), we can presumably resolve some seemingly puzzling features in models that impose a constant subjective discount rate. Uzawa (1968), which first introduced the concept of an endogenous discount factor in the literature, noted that a constant subjective discount rate and a constant interest rate would produce an unrealistic scenario in which the consumer would either save all the income or save nothing, except for the knife-edge case in which the subjective discount rate is equal to the interest rate. Uzawa shows that an endogenous discount factor would produce a more realistic scenario that gets away from the two extreme cases.

Obstfeld (1981) developed the first open-economy macro model that has incorporated an endogenous discount rate (but no HO feature). In the model, accumulation of the economy's external assets attains a stationary state when the (endogenous) discount rate reaches the level of an (exogenous) world interest rate. The endogenous discount rate ensures the existence of a stable perfect foresight equilibrium path that converges to the stationary state. Another important paper with an endogenous discount rate (but no HO feature)

[2] Note that the usual motivation for an endogenous discount factor in a dynamic open-economy model is either to make the steady state different from initial conditions or to make the current account adjustment more persistent. We assume an endogenous discount factor because we find it both philosophically attractive in capturing a realistic feature of the world and technically useful in addressing the problem of interest rate over-determination.

is an open-economy real business cycles model developed by Mendoza (1991). The model produces a well-defined stationary equilibrium in an economy's holdings of foreign assets.

Epstein (1983) argued that an endogenous discount rate is a natural feature in a world with uncertain future incomes, and helps to ensure that consumption in every period is a normal good. Other papers have demonstrated that an endogenous discount rate can help resolve other seemingly puzzling observations such as a low real interest rate when the government spending is high (Devereux, 1991) or no country owns all the wealth in the world even if some countries are more patient initially (Daniel, 1997).

In short, an endogenous discount factor has a long intellectual history and has been found useful in understanding many macroeconomic phenomena including the dynamics of current account or foreign asset holdings. Our paper is the first that combines an endogenous discount factor with a dynamic HO model. As a result, we are able to study the effects of a permanent shock to trade costs on the current account.

To complete our framework, we also have to address another technical challenge. In particular, the standard Heckscher-Ohlin model imposes a balanced trade assumption, which rules out capital flows and non-zero current account. To have a meaningful discussion of current account changes, we abandon the (unrealistic) restriction of a balanced trade. But this raises a different issue, namely, capital flows and goods trade are perfect substitutes in the absence of any frictions, as was pointed out by Mundell (1957). In other words, the HO structure without the balanced trade assumption inherently has multiple equilibria. (Or the balanced trade assumption is a particular way to select an equilibrium out of infinitely many possibilities.) To avoid multiple equilibria, we follow Neumeyer and Perri (2005) and Schmitt-Grohe and Uribe (2003) and assume convex costs of adjusting the international asset position.

Convex adjustment costs for international asset position can also render the steady state independent of initial conditions. In our context, this assumption helps to address the technical challenge of multiplicity of equilibria. With linear costs of trade in goods and/or capital, corner solutions occur: either goods trade or capital flow takes place, but the two do not coexist.[3] Once we assume convex costs of adjusting international asset position, we

[3] For more detailed discussions on this point, readers are guided to Ju and Wei (2007).

can pin down equilibrium capital flows and current account. In an extension to the model when we introduce costs of adjustment of labor and capital across sectors, the multiple equilibria problem is resolved as well.

4.1 Household

The economy is inhabited by a continuum of identical and infinitely lived households that can be aggregated into a representative household. The representative household's preference over consumption flows is summarized by the following time-separable utility function

$$U = \sum_{s=t}^{\infty} \theta_s U(C_s) \tag{4.2}$$

where C_s is the household's consumption of a final good at date s, and θ_s is the discount factor between period 0 and s as given by

$$\theta_{s+1} = \beta(\tilde{C}_s, \widetilde{Y}_s)\theta_s, \ \ s \geq 0 \tag{4.3}$$

where $\theta_0 = 1$ and $\frac{\partial \beta(\tilde{C}_s)}{\partial \tilde{C}_s} < 0$ and $\frac{\partial \beta(\widetilde{Y}_s)}{\partial \widetilde{Y}_s} > 0$. 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 $\tilde{C}_s$ and income $\widetilde{Y}_s$, which the representative household takes as given.[4] The exact functional form of $\beta(\tilde{C}_s, \widetilde{Y}_s)$ will be presented later. The household owns both factors of production, capital K and labor L. 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 B_t to smooth consumption. Following Neumeyer and Perri (2005), we assume that trade in foreign bonds is subject to small and convex portfolio adjustment costs. If the household holds an amount B_{t+1}, then

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

these portfolio adjustment costs, denominated in units of the final good, are $\frac{\psi_b}{2}(B_{t+1}-\bar{B})^2$,[5] where $\bar{B}$ is an exogenous capacity level of foreign asset management. For simplicity, we assume $\bar{B}=0$.

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

$$\begin{aligned} & P_t[C_t + \frac{\psi_b}{2}(B_{t+1}-\bar{B})^2] + B_{t+1} + I_t \\ = \; & w_t L + r_t K_t + (1+r^*)B_t + TR_t \end{aligned} \tag{4.4}$$

$$K_{t+1} = (1-\delta)K_t + I_t - \frac{1}{2}\psi_k(\frac{I_t}{K_t}-\delta)^2 K_t \tag{4.5}$$

where I_t is investment in period t, and w_t and r_t are the wage and the domestic return to capital, while r^* is the world interest rate. δ is the capital appreciation rate and ψ_k is the aggregate capital adjustment cost coefficient. The tariff revenue, TR_t is rebated in a lump sum to the representative consumer, which is taken as exogenous by the consumer.[6]

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

$$\frac{U_c'(C_t)}{P_t} = \Omega_t \tag{4.6}$$

$$\Lambda_t(1-\psi_k(\frac{I_t}{K_t}-\delta)) = \Omega_t \tag{4.7}$$

$$\Lambda_t = \beta(\tilde{C}_t,\widetilde{Y}_t)\left[\Lambda_{t+1}\left(1-\delta+\frac{\psi_k}{2}(\frac{I_{t+1}}{K_{t+1}}-\delta)(\frac{I_{t+1}}{K_{t+1}}+\delta)\right)+\Omega_{t+1}r_{t+1}\right] \tag{4.8}$$

$$\Omega_t\left[1+\psi_b P_t(B_{t+1}-\bar{B})\right] = \beta(\tilde{C}_t,\widetilde{Y}_t)[\Omega_{t+1}(1+r^*)] \tag{4.9}$$

where Ω_t and Λ_t are Lagrange multipliers for the budget constraint and the law of motion for capital, respectively.

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

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

4.2 Production

The production function for the final good is $D_t = G(D_{1t}, D_{2t})$, where D_{it} is the usage of intermediate good i by the final good producer. The production function for the intermediate good $i(=1,2)$ is $X_{it} = f_i(A_{it}L_{it}, K_{it})$ where A_{it} measures labor productivity. $H_{it} = A_{it}L_{it}$ can be understood as units of *effective labor.* All production functions are assumed to be homogeneous of degree one. D_{it} and X_{it} can differ due to international trade.

The unit cost function for X_{it} is $\phi_i(\frac{w_t}{A_{it}}, r_t)$. Let P_i be the domestic price of intermediate good i. We assume that the country's endowment is always within the diversification cone so that both intermediate goods are produced. In each period t, free entry and zero profits in both the intermediate good and the final good markets imply that

$$P_{1t} = \phi_1(\frac{w_t}{A_{1t}}, r_t), P_{2t} = \phi_2(\frac{w_t}{A_{2t}}, r_t) \tag{4.10}$$

$$P_t D_t = P_t G(D_{1t}, D_{2t}) = P_{1t}D_{1t} + P_{2t}D_{2t} \tag{4.11}$$

4.3 Equilibrium

In equilibrium, trade in intermediate goods equalizes (tariff-inclusive) good prices between the home country and the rest of the world in every period. Without loss of generality, we assume that sector 1 is labor intensive while sector 2 is capital intensive. Considering a labor abundant country which exports labor intensive good 1, we have:

$$P_{1t} = P^*_{1t},\ P_{2t} = (1+\tau)P^*_{2t}, \tag{4.12}$$

where P^*_{it} denotes the world price and is exogenously given, and τ is the import tariff. Following the standard assumptions in the Hecksher-Ohlin model, we assume that production functions (and unit cost functions) in all countries are the same (although labor-augmenting productivity can be different). Therefore, in the foreign country we also have:

$$P^*_1 = \phi_1(\frac{w^*}{A^*_1}, r^*),\ P^*_2 = \phi_2(\frac{w^*}{A^*_2}, r^*) \tag{4.13}$$

For simplicity, we assume that the rest of the world is in steady state so the return to capital, r^*, is a constant. We will leave out the time subscript for all foreign variables from now on. We have the following market clearing conditions in the home country

$$K_t = K_{1t} + K_{2t} \tag{4.14}$$

$$L_t = L_{1t} + L_{2t} \tag{4.15}$$

$$D_t = C_t + \frac{I_t}{P_t} + \frac{\psi_b}{2}(B_{t+1} - \bar{B})^2 \tag{4.16}$$

Equation (4.16) 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 t is defined as $CA_t = B_{t+1} - B_t$; thus, noting that $P_{it}X_{it} = w_t L_{it} + r_t K_{it}$ and using equations (4.11) and (4.16)), we can rewrite the budget constraint as

$$CA_t = P^*_{1t}(X_{1t} - D_{1t}) + P^*_{2t}(X_{2t} - D_{2t}) + r^* B_t \tag{4.17}$$

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 gross domestic product as $Y_t = \frac{P_1 X_{1t} + P_2 X_{2t}}{P_t}$.

5 Equilibrium Analysis

To study the equilibrium explicitly, we adopt the following standard functional forms for preference and technology. The utility function is $U(C_t) = \frac{{C_t}^{1-\gamma}}{1-\gamma}$, where γ is the inverse of the elasticity of intertemporal substitution. The production function for the final good is $G(D_{1t}, D_{2t}) = \frac{1}{\omega^\omega (1-\omega)^{1-\omega}} D_{1t}^\omega D_{2t}^{1-\omega}$, where ω is the share of intermediate good D_1 in the final good production. The production function for intermediate good i is $f_i(A_{it}L_{it}, K_{it}) = \frac{1}{\alpha_i^{\alpha_i}(1-\alpha_i)^{1-\alpha_i}} K_{it}^{\alpha_i}(A_{it}L_{it})^{1-\alpha_i}$, where α_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 discount factor takes the following function form:

$$\beta(\tilde{C}_t, \widetilde{Y}_t) = \beta(\frac{\tilde{C}_t}{\bar{C}})^{-\psi_1}(\frac{\widetilde{Y}_t}{\overline{Y}})^{\psi_2} \tag{5.18}$$

where $\psi_1 > 0$ and $\psi_2 > 0$. $\bar{C}$ and $\overline{Y}$ are, respectively, the consumption and output levels in the initial steady state with tariff τ_0. This form is a variant of Choi, Mark and Sul (2008). When the representative consumer consumes less than the initial steady state, she becomes less patient. That is the implication of this type of discount factor. In the new steady state after a tariff reform, the endogenous discounted factor would deviate from the constant β. To make the model parsimonious, we assume $\psi_1 = \psi_2 = \psi$.

5.1 The Effects of Trade Liberalizations

For simplicity, we assume that $A_1^* = A_2^* = 1$. In equilibrium, given the production functions, from Equation (4.10), we have

$$(\frac{w_t}{A_{1t}})^{1-\alpha_1} r_t^{\alpha_1} = P_1^*,\ (\frac{w_t}{A_{2t}})^{1-\alpha_2} r^{\alpha_2} = (1+\tau)P_2^* \tag{5.19}$$

which give

$$r_t = r^*[(\frac{A_{1t}}{A_{2t}})^{(1-\alpha_1)(1-\alpha_2)} \frac{1}{(1+\tau)^{(1-\alpha_1)}}]^{\frac{1}{\alpha_1-\alpha_2}} \tag{5.20}$$

$$w_t = w^*[\frac{A_{1t}^{(1-\alpha_1)\alpha_2}}{A_{2t}^{\alpha_1(1-\alpha_2)}} \frac{1}{(1+\tau)^{\alpha_1}}]^{\frac{1}{\alpha_2-\alpha_1}} \tag{5.21}$$

Three comparative statics can be immediately seen: (a) $\frac{\partial r_t}{\partial \tau} > 0$, (b) $\frac{\partial r_t}{\partial A_{1t}} < 0$, and (c) $\frac{\partial r_t}{\partial A_{2t}} > 0$. By inequality (a), trade liberalization in a labor abundant country (a reduction in τ) reduces the return to capital. 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 effect. 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 ($\frac{A_{1t}}{A_{2t}}$ 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 tariff reduction in the capital intensive sector implies a decrease in the price of capital intensive goods, therefore, r_t decreases but w_t increases.

It is worth emphasizing that the discussion points to a natural asymmetry between developed (capital abundant) and developing (labor abundant) countries. Trade liberalizations tend to reduce the domestic return to capital for a developing country, but to raise it for a developed country.

5.1.1 Net Foreign Asset Positions

We consider two cases of the effects on net foreign asset positions, B_t. First, in the transitional dynamics, we assume that the investment adjustment cost ψ_k is zero. Using equations (4.7), (4.8) and (4.9), we obtain:

$$B_{t+1} = \frac{1}{\psi_b P_t} \frac{r^* - r_{t+1} + \delta}{1 + r_{t+1} - \delta} \tag{5.22}$$

The holding of foreign bond B_{t+1} is a function of r_{t+1} and $\frac{\partial B_{t+1}}{\partial r_{t+1}} < 0$. Second, in the steady state, using first order conditions (4.7), (4.8) and (4.9), we obtain:

$$B = \frac{1}{\psi_b P} \frac{r^* - r + \delta}{1 + r - \delta} \tag{5.23}$$

That is, when the return to capital in the country decreases, capital flows out so that the net foreign asset increases in the steady state. Note that the result for net foreign asset positions does not likely depend on the assumption of an endogenous discount factor, $\beta(\tilde{C}_t, \widetilde{Y}_t)$. For any form of discount factor (endogenous or exogenous), the net foreign asset position must increase if the domestic interest rate declines. We summarize our discussion by the following proposition:

Proposition 1 *A 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 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.*[7]

5.1.2 Steady State

Using the Euler equation in the steady state (4.8) and the function of endogenous discount factor (5.18), we solve for the ratio of consumption to income.

$$c_y = \frac{\overline{C}}{\overline{Y}}[\beta(1 + r - \delta)]^{\frac{1}{\psi}} \tag{5.24}$$

where $c_y = \frac{C}{Y}$ and $\overline{C}$ and $\overline{Y}$ are the consumption and income level in the initial steady state, respectively. Clearly, $\frac{\partial c_y}{\partial r} > 0$. Note that the interest rate is determined by the production side (along the demand curve of capital). A decrease in the interest rate implies that the combined size of capital stock and foreign asset holding in the new steady state is larger, which requires that the household becomes more patient and consumes less relative to income.

The return to factors (r, w) and the holding of foreign asset (B) are given by equations (5.20), (5.21) and (5.23). Given that, we can solve for the demand for the final good, D, consumption, C, investment I and Gross Domestic Product, Y and sectoral outputs X_1 and X_2 from the set of equations listed in Appendix 7.1. We can write the sectoral outputs as below

$$P_1X_1 = \frac{wL - (1-\alpha_2)(1+\tau)(\zeta PD - r^*B)}{(1-\alpha_1) - (1+\tau)(1-\alpha_2)} \tag{5.25}$$

$$P_2X_2 = \frac{(1-\alpha_1)(1+\tau)(\zeta PD - r^*B) - (1+\tau)wL}{(1-\alpha_1) - (1+\tau)(1-\alpha_2)} \tag{5.26}$$

where $\zeta = \omega + \omega/(1+\tau)$. The optimization conditions for the final good producer yield

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[7]Let t_c be the iceberg trade cost, we will have: $P_{1t} = \frac{P_1^*}{1+t_c}$ and $P_{2t} = (1 + t_c + \tau)P_2^*$. It is immediately seen that a reduction in trade cost will increase the price of the labor intensive good, P_{1t}, but reduce P_{2t}. Similar to the analysis of the tariff reduction, a reduction in trade cost will result in a decrease in r. On the other hand, if the home country were a capital abundant country and exporting good 2, we would have $P_{2t} = \frac{P_2^*}{1+t_c}$ and $P_{1t} = (1 + t_c + \tau)P_1^*$. Now a reduction in tariff or trade cost would reduce the price of the labor intensive good, P_{1t}, but increase P_{2t}, which would increase r.

$P_1 D_1 = \omega P D$. Thus the exports of intermediate good 1 are given by

$$NX_1 = P_1(X_1 - D_1) = P_1 X_1 - \omega P D \tag{5.27}$$

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

$$K_i = \alpha_i \frac{P_i X_i}{r},\ L_i = (1-\alpha_i)\frac{P_i X_i}{w},\ \text{and} \tag{5.28}$$

$$\frac{K_i}{L_i} = \frac{\alpha_i}{1-\alpha_i}\frac{w}{r} \tag{5.29}$$

A tariff cut in the capital intensive sector will lead to 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.

5.2 Calibrations 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 Perri, 2002) as much as possible. The parameter values are summarized in Table 3. We set the inverse of the elasticity of intertemporal substitution $\gamma = 2$, the steady state discount factor $\beta = 0.99$, which implies a 4 percent annual world interest rate. We assume an equal share of the intermediate goods in the final good production, so $\omega = 0.5$. We choose $\alpha_1 = 0.33$ and $\alpha_2 = 0.7$ so that both the average labor share and the average dispersion of the labor shares in the model economy are the same as those estimated from China's input-output Table in 2002. We set capital adjustment cost $\psi_k = 4$ 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 at 10%, which implies $\delta = 0.025$. Following Schmitt-Grohe and Uribe (2003), the coefficient for bond adjustment costs, ψ_b, is set to be 0.0007. We set $\psi = 0.1$, which is close to the value chosen by Choi, Mark and Sul (2008). A summary of the parameter choices is presented in the following table.

Table 3: Parameter Values in the Calibrations

β	discount factor in steady state	0.99
γ	inverse of the elasticity of intertemporal substitution	2
α_1	capital share in sector 1	0.33
α_2	capital share in sector 2	0.7
ω	share of goods 1 in final good	0.5
ψ_b	coefficient for convex bond adjustment costs	0.0007
δ	capital depreciation rate	0.025
ψ	parameter of endogenous discount factor	0.1
ψ_k	coefficient of capital adjustment cost	4
A_1	productivity in sector 1	0.8
A_2	productivity in sector 2	0.50207

In the initial steady state, the economy is assumed to impose a 15% tariff on imports of the capital intensive good, while the rest of the world has no tariff. We further choose the values of the productivity parameters to make $r = r^*$ so that $B = 0$, and the domestic wage is lower than that in the rest of the world. We cannot use the Euler equation to determine the level of aggregate consumption $\bar{C}$ and output $\overline{Y}$ as there are multiple equilibria. As long as the country's capital-labor ratio K/L is between $\frac{K_1}{L_1}$ and $\frac{K_2}{L_2}$, any level of capital stock K could be an equilibrium. A smaller K 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 to Appendix 7.2.

For the initial productivity, we set $A_1 = 0.8$ and $A_2 = 0.50207$ so that in the initial steady state, given the tariff level, the returns to capital across countries are equalized and the wage in the domestic economy is lower than that in the rest of the world.

We consider two policy experiments of reducing the import tariff by 5 and 10 percentage points, respectively. In columns 2, 3 and 4 of Table 4, we report the values for both the initial steady state (when the tariff=15%) and the new steady states (when the tariff = 10% and 5%, respectively). Price variables, aggregate quantity variables, sectoral variables, and balance-of-payments (BOP) variables are organized in four panels. The numerical results confirm Proposition 1. In particular, the return to capital, $r_1 = r_2$, declines while the wage rate, $w_1 = w_2$, rises. In the new steady state after the tariff cut, aggregate consumption C, investment I, and GDP Y all increase. The labor intensive sector (Sector 1) expands so that K_1, L_1 and X_1 all increase, while the capital intensive sector (Sector 2) contracts. Both exports (NX_1) and imports ($-NX_2$) expand. The trade volume to GDP ratio, TV/GDP, increases by 7 percentage points. Most interestingly, exports expand faster than imports, and capital flows out of the country so that the cumulative increase in the foreign asset holding as a share of GDP ratio, reaches the level of 29%. In other words, a relatively moderate tariff reduction (from 15% to 10%) results in a significant capital outflow.

In the second policy experiment, a more substantial (but still realistic) tariff reduction by 10 percentage points (from 15% to 5%) leads to an even greater increase in foreign asset holding to 56% of GDP.

There are also interesting byproducts of the trade reforms. In particular, consumption as a share of GDP declines while investment to GDP ratio increases. To be precise, both consumption and output expand from the old to the new steady state (see the row labeled as "C" in Table 4), so the decline in the ratio of consumption to GDP comes from uneven speeds of expansion, not from a decline in consumption in the steady level. This is an interesting bonus finding. Chinese data in recent years exhibit a declining ratio of consumption to GDP, and it is commonly interpreted to be a result of some policy distortions (either exchange rate manipulation or financial repression). Our calibration generates such a feature as a result of a reduction in policy distortions (tariffs).

In Figure 3, we report the dynamic paths of the economy from the initial to the new steady state after a 5 percentage points cut in the tariff (from 15% to 10%). 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 K_1, L_1, and X_1, while sector 2 contracts immediately, with a decline in K_2, L_2, and X_2. As a result, both the export share sx and import share $-sm$ increase immediately. As noted, the consumption response is interesting. After a decline in the first several periods, consumption rises gradually. Intuitively, because the domestic return to capital declines after the trade reform, the endogenous discount factor specification implies that the representative household must become more patient. This in turn causes the household to have a lower ratio of consumption/income (or a higher savings rate) both during the transition and in the new steady state. (It is important to reiterate that we can see, from Table 4, that the absolute level of consumption does go up in the new steady state. In other words, trade reforms do raise consumption, but not the ratio of consumption to GDP.)

In Figure 4, we report the dynamic paths for some key balance-of-payments items. From the top left graph, we observe that the trade volume (the sum of exports and imports as a share of GDP) jumps immediately. This is not surprising as both imports and exports expand.

There are three ways of viewing a country's current account: (a) as net capital outflows, (b) as the sum of trade balance and net international factor payment, and (c) as the difference between national savings and national investment. In this case, thinking of the current account as net capital outflows turns out to be most convenient in terms of obtaining intuition for our result. Following a tariff cut (on capital intensive goods), Proposition 1 in Section 4.1.1 points out that domestic return to capital would decline if all other things can be held constant (including imposing a closed capital account). Of course, other things cannot be held constant. In particular, if the domestic return to capital falls, it immediately creates incentive for a capital outflow. This is why a current account surplus tends to follow a tariff reform that reduces the domestic price of capital intensive goods. The thick line in the upper right graph traces out the trajectory of current account as a share of GDP which exhibits a positive current account for over 20 quarters before converging to zero. In our model economy, the bottom right graph shows how B/GDP increases gradually to the new steady state level (of 29% of GDP).

Of course, the other two ways of thinking about the current account also have to hold as a matter of identities. In the top right graph, the broken thin line traces the trade balance as a share of GDP. This variable jumps into a surplus immediately following the tariff cut, reaching somewhere around 5 percent of GDP, but goes into a deficit after about 20 quarters since it has to offset the positive interest payment the country receives from its foreign asset holdings in order to produce a zero current account.

The identity that current account is the difference between national savings and investment is also respected. The trajectories for savings and investment as shares of GDP are plotted in the lower left graph. In the graph, the savings rate goes up immediately after the trade reform, while the investment rate goes up after an initial and temporary fall. The gap between savings and investment is always equal to the current account indicated by the thick line in the upper right graph.

Note that the domestic investment (as a share of GDP) can go either up or down, depending on the parameter values. The initial decrease in investment ratio reflects the immediate expansion of the labor intensive sector and the contraction of the capital intensive sector after the tariff cut, which result in the lower domestic demand for investment. It is important to note that we only consider here a case in which there is no technological change accompanying a trade reform. In the real data, there is often technological improvement that accompanies a trade reform. In our model, technological improvements either uniformly across both sectors (both A_1 and A_2 increase proportionally), or just in the comparative advantage sector (A_1 increases), would lead to an immediate jump in the investment to GDP ratio. (In other words, if a trade reform is modeled as a combination of a tariff cut and an increase in productivity, then there will be a large current account surplus without much initial fall in the investment/GDP ratio.)

Handley and Limao (2016) argue that the PNTR reform in late 2000 is equivalent to a permanent cut in the US tariff rate by 13 percentage points (on mostly labor intensive products). For Chinese exporters, this is also equivalent to an export cost reduction. During the period from 2001-2007, the exports to the US are about 15 percent of China's total exports on average. Therefore, we assume that the PNTR effect is equivalent to 2 percent of export cost reduction on Chinese exporters. In Figure 4A, we report the dynamic responses of trade volume and balance of payment variables to a simultaneous reduction of tariff by 5 percentage points and a reduction in export costs by 2%. With the extra cut in the export costs, the initial trade volume/GDP increases from 38% to 45%, and the initial current account/GDP increases from 5.38% to 5.88%. For the foreign asset holding in the new steady state, it increases from 29% to 33%. The overall effect of export cost reduction is significant, but quantitatively smaller than that of tariff reduction. This is simply because the reduction of import tariff is for all the imports while the export cost reduction is only for the US market.

We now perform some sensitivity analysis. First, we investigate transitional dynamics when we vary the aggregate capital adjustment cost $\psi_k = 4$, 8, and 12. The results are presented in the top row of Figure 5. Although the steady state is not affected by changes in ψ_k, the trade volume, the current account and the foreign asset position in the transition dynamics become (moderately) larger when ψ_k becomes smaller. The overall dynamics of the balance of payments does not appear to be very sensitive to perturbations in the value of aggregate capital adjustment costs.

Second, we investigate the BOP dynamics at different bond adjustment costs. As equation (5.23) indicates, the change in the foreign asset position from the initial to the new steady state is affected by the bond adjustment cost, ψ_b. In the second row of Figure 5, we report the transitional dynamics under the assumption of two new values of ψ_b, 0.0005 and 0.0010, in addition to the benchmark value of 0.0007. In all cases, the country still runs a current account surplus after a tariff cut with each of the two alternative bond adjustment costs. The quantitative effect, however, varies. As expected, a smaller bond adjustment cost results in a larger current account surplus in transitional dynamics, and larger trade volume and net foreign asset position in both transitional 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 a RBC model to explain the business cycles in the Chinese economy, Curtis and Mark (2010) also choose $\psi_b = 0.0007$ as the value for the bond adjustment cost. Therefore, we regard $\psi_b = 0.0007$ as the "right" benchmark value.

6 Factor Market Frictions

Factor market reforms can affect how a country's current account responds to a given trade reform. For the current account to respond to trade reforms, a key intermediary step is a structural adjustment of the domestic economy. Logically, factor market frictions that block or reduce the extent of the domestic structural adjustment can also block or reduce the current account response to trade reforms. We now turn to this topic. We start with financial frictions in the form of credit constraints.

6.1 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 tariff 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 K is owned by a total K of capitalists. A proportion ξ of K 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 θ amount of her own capital. Thus the total amount of capital employed in the exporting sector is given by,

$$K_{1t} \leqslant (1+\theta)\xi K_t = \mu_k K_t \tag{6.30}$$

where $\mu_k = (1+\theta)\xi$. We focus on the case in which financial frictions are binding (or μ is sufficiently small) so that $\mu_k K$ is less than the desired amount of capital that exporting firms would like to employ in the absence of financial frictions.

Let r_i be the return to capital in sector i. The financial frictions cause a wedge between the returns to capital in the two sectors, $r_{1t} > r_{2t}$. The budget constraint (4.4) now is changed to

$$\begin{aligned} & P_t[C_t + \frac{\psi_b}{2}(B_{t+1} - \bar{B})^2] + B_{t+1} + I_t \\ = \quad & w_t L + \sum_{i=1}^{2} r_{it} K_{it} + (1+r^*)B_t + TR_t \end{aligned} \tag{6.31}$$

In addition to the capital accumulation equation, the representative household also faces the credit constraint (6.30) and capital market clearing condition, $K_{1t} + K_{2t} = K_t$. When the credit constraint (6.30) is binding, we have $K_{1t} = \mu_k K_t$ and $K_{2t} = (1 - \mu_k) K_t$. Using these results, the budget constraint (4.4) now becomes:

$$\begin{aligned} & P_t[C_t + \frac{\psi_b}{2}(B_{t+1} - \bar{B})^2] + B_{t+1} + I_t \\ = \quad & w_t L + [\mu_k r_{1t} + (1 - \mu_k) r_{2t}] K_t + (1 + r^*) B_t + TR_t \end{aligned} \tag{6.32}$$

Therefore, the first order conditions with respect to C_t, K_{t+1}, B_{t+1}, and L_{it} in the consumer's maximization problem now remain the same as conditions (4.6), (4.8), and (4.9) except that we now replace r_{t+1} by

$$r^C_{t+1} = \mu_k r_{1,t+1} + (1 - \mu_k) r_{2,t+1} \tag{6.33}$$

6.1.1 The Steady State Equilibrium

The steady state 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 (5.23), in the steady state we have

$$B = \frac{1}{\psi_b P} \frac{r^* - r^C + \delta}{1 + r^C - \delta} \tag{6.34}$$

Thus, $r^C = \mu_k r_1 + (1 - \mu_k) r_2$, is a key variable in determining the country's net foreign asset holding B.

Because we are not able to obtain an analytic solution, we will resort to numerical results. Here we offer some intuition for the numerical results to come. When financial frictions become tighter (μ_k declines), the capital usage in sector 1 declines. As a result, the marginal product of capital in the exporting sector, r_1, increases, but the marginal product of labor, w_1, declines. Since the wage rates are equalized in the two sectors in the steady state, $w_1 = w_2 = w$, using the zero profit condition in the import-competing sector, $P_2 = \phi_2(\frac{w_2}{A_2}, r_2)$, we infer that the marginal product of capital in the import-competing sector, r_2 must rise. Since both r_1 and r_2 are larger, therefore, r^C becomes larger as financial frictions becomes tighter. Using (6.34), that results in a smaller B. 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.

Several recent papers (Caballero, Farhi, and Gourinchas, 2008; Mendoza, Quadrini, and Rios-Rull, 2009; Ju and Wei, 2010; and Song, Storesletten, and Zilibotti, 2011) have showed that a low level of financial development in a developing country can produce a financial capital outflow to developed countries. Therefore, a tighter financial friction would lead to more current account surplus in a developing country. Our paper, however, suggests the opposite. When credit constraint is asymmetric across sectors, for example, when there is a credit rationing in one sector but not in another sector, similar to the setup in Antras and Caballero (2009), we show that a tighter credit constraint induces capital inflow (or a smaller current account surplus). The two parts of the literature can be reconciled when one realizes that the first set of papers emphasizes the effect of financial frictions on the supply side of capital (financial frictions reduce the return on savings and generate incentives to move savings out of the country), while the current paper and Antras and Caballero (2009) stress the demand side effect (credit constraints could increase demand for capital by firms in the unconstrained sector). Our model is different from Antras and Caballero (2009) in that trade liberalization always leads to capital outflow (current account surplus) under credit constraints, although the amount of capital outflow could be made smaller by a tighter credit constraint.

6.2 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 certain proportion of the 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:

$$L_{1t} \leqslant \mu_L L \tag{6.35}$$

Similarly, the budget constraint (4.4) now becomes

$$\begin{aligned} & P_t[C_t + \frac{\psi_b}{2}(B_{t+1} - \bar{B})^2] + B_{t+1} + I_t \\ = \quad & [\mu_L w_{1t} + (1 - \mu_L)\, w_{2t}]\, L + r_t K_t + (1 + r^*) B_t + TR_t \end{aligned} \tag{6.36}$$

and all the analysis in the basic model goes through except that now we replace w_t by $w_t^c = \mu_L w_{1t} + (1 - \mu_L)\, w_{2t}$. 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.

6.3 Numerical Results

For numerical simulations, we focus on the case of credit constraints, while assuming no labor market frictions. (The results with labor market frictions are qualitatively similar.) 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 $\mu_k = 0.42$ so that the initial net export share is about 10%.

The case of a tariff reduction from 15% to 10% under financial frictions is presented in Columns 5 and 6 in Table 4. The return to capital in the importing sector, r_2, decreases, but r_1 in the exporting sector increases. The labor intensive sector expands while the capital intensive sector shrinks, and both exports and imports increase. While the qualitative result is the same as the case without financial frictions (Columns 2 and 3 in Table 4), the magnitude of the changes is (much) smaller. Because the (labor-intensive) export sector cannot expand as much as before, the wage rate now declines. The ratio of the trade volume to GDP, $\frac{TV}{GDP}$, increases by 3.7 percentage points (from 21.1% to 24.8%), compared to an increase by 6.6 percentage points when there is not credit constraint. The increase in the net foreign asset position, B/GDP, is on the order of 10% of GDP when there is credit constraint, compared to an increase by 29% of GDP in the absence of credit constraints.

If the tariff is cut to 5%, the new steady state (with credit constraint) is presented in Column 7 of Table 4. Again, comparing the change in the country's foreign asset position from Columns 5 to 7, with the change in the same variable from Column 2 to 4, it is clear that credit constraint can substantially reduce the change in a country's foreign asset position for a given trade reform.

We present, in Figure 6, the transitional dynamics of the economy after a tariff cut from 15% to 10% in the case with credit constraints. Compared to Figure 3 (the transitional dynamics after an identical tariff cut but without credit constraint), the adjustments are smaller. The implications of credit constraints for the balance-of-payments variables are best seen in Figure 7. For ease of comparison with the case of no credit constraint, we use thick bold lines to represent the transitional dynamics when there is credit constraint, and thin lines to represent the case of no credit constraint. From the upper left graph, it is clear that credit constraints reduce the impact of a given tariff cut on trade volumes. Similarly, in the lower left graph, we can see that credit constraints induce a smaller current account response to the same tariff cut than the case of no credit constraints. From the upper right graph, we can see that the smaller current account response comes from a combination of a smaller savings response and a smaller investment response. Unsurprising, as shown in the lower right graph, the accumulation of foreign assets is also stunted by credit constraints.

7 Concluding Discussion

A wave of trade liberalizations take place in both developing and developed countries, including China's trade reforms during 2001-2006 following its WTO accession and the end of import quotas on textiles and garments in the United States and Europe in 2004. At the same time, both China's current account surplus and the US deficit have risen to an unprecedented level. We suggest that the two developments are intimately related. By embedding a modified Heckscher-Ohlin structure and an endogenous discount factor into an intertemporal model of current account, we obtain two key results. First, trade liberalizations in a developing country (that reduce its capital intensity) would generally lead to a capital outflow, while trade liberalizations in a developed country (that increase its capital intensity) would result in a capital inflow. Thus, trade reforms can produce or contribute to global imbalances. Because such current imbalances are generated by welfare-improving trade reforms, they do not call for a policy correction. Second, factor market frictions can reduce the current account response to trade reforms by reducing the extent of economic structural change.

This model offers an interesting interpretation of the Chinese experience with trade reforms and current account dynamics (both the rapid rise during 2002-2007 and the fall after 2007). In particular, there are two phases of trade policy changes that appear to be associated with different current account patterns. Before China's accession to the WTO at the end of 2001, while there had been trade reforms, financial sector frictions may have blunted the current account response. In comparison, the WTO accession represents a watershed event in two senses. First, not only the dismantling of tariff and non-tariff barriers on imports was accelerated, there was also a dramatic reduction in trading costs faced by firms in the exporting sector. In particular, Chinese firms that did not enjoy export rights before the WTO accession acquired an automatic right to exports as a result of the accession. (This reduction in trade costs is not captured by any measured reduction in tariff rates.) If one counts the number of trade reforms China has to undertake, it is more than two standard deviations greater than the median value for an accession country since 1990 (Tang and Wei, 2009). In that sense, China's trade reforms associated with its WTO accession may be called the mother of all trade reforms. 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 facilitated the economic adjustment in the direction of expanding China's comparative advantage sectors and reducing its comparative disadvantage sectors.

The difference between the trade reforms in the 1990s and those associated with the WTO accession can be seen from the time series of the import-to-GDP ratio. The tariff cuts before 2001 had led to only a small change in the import/GDP ratio. In comparison, the WTO accession was followed by a large and sustained increase in the imports from 5% of GDP in 2001 to close to 30% of GDP by 2007. Interpreted in light of our model, the combination of trade reforms and factor market reforms brought out by the WTO accession has the effect of producing a large and positive current account response. Because both trade reforms and financial reforms were conducted over a multi-year phase, the current account response gains strength over time in the first few years after the WTO accession before it peters off.

Our theory also sheds new light on the relative decline in China's current account surplus after 2007. A common explanation for the current account contraction is a temporary reaction to the contraction of global trade associated with the global financial crisis. The implication is that the Chinese current account surplus could return to its pre-2007 level once the world economy is out of the recession. However, our model provides an additional explanation. In our model, the current account response to a trade policy shock is temporary (even though it can last for 20 quarters). Therefore, part of the decline of the current account surplus could result from the end of major trade reforms. The change in current account due to this factor is not likely to be reversed.

The end of the import quotas on textiles 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 textiles and garments are an important comparative advantage sector for China, the end of quotas in 2004 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. Because Europe is commonly said to have a less flexible labor market, our theory would predict a smaller current account response to the trade policy response, which appears to be consistent with the pattern in the data.

We do not wish to claim that trade reforms are the only factor that matters for the evolution of a country's current account. Rather, it is an important contributing factor that is thus far neglected in the discussion of current account imbalances. Such omission could incorrectly color one's understanding of the source of current account imbalances and appropriate policy responses. To put it simply, if a portion of the current account imbalances is caused by efficient trade reforms, we do not need to view it as a problem that needs a policy correction.

The basic general equilibrium logic linking trade reforms and capital flows is not unique to China. We will see many more trade policy changes in both developed and developing countries (not always in the direction of reducing trade barriers). We will also see many more changes in factor markets around the world that could either enhance or reduce their flexibility. This paper provides a way to think about the general equilibrium implications of trade reforms for international capital flows.

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8 Appendices

8.1 Equations for the Steady State

Given the factor prices (w, r) and the holding of foreign asset B, the output Y, consumption C, investment I, aggregate demand D, and sectoral outputs X_1 and X_2 can be determined by the following six equations.

$$\frac{C}{Y} = \frac{\overline{C}}{\overline{Y}}[\beta(1 + r - \delta)]^{\frac{1}{\psi}} \tag{8.1}$$

$$D = C + \frac{I}{P} + \frac{\psi_b}{2}B^2 \tag{8.2}$$

$$PY = P_1X_1 + P_2X_2 \tag{8.3}$$

$$\alpha_1P_1X_1 + \alpha_2P_2X_2 = r\frac{I}{\delta} \tag{8.4}$$

$$(1 - \alpha_1)P_1X_1 + (1 - \alpha_2)P_2X_2 = wL \tag{8.5}$$

$$P_1X_1 + P_2X_2/(1 + \tau) + r^*B = \zeta PD \tag{8.6}$$

where $\zeta = \omega + (1 - \omega)/(1 + \tau)$. Equation (8.6) is derived from the current account equation in the steady state, $P_1^*(X_1 - D_1) + P_2^*(X_2 - D_2) + r^*B = CA = 0$.

8.2 Equilibrium Selection in the Initial Steady State

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

$$sx = \frac{NX_1}{P_1X_1 + P_2X_2} > 0 \tag{8.7}$$

$$sm = \frac{NX_2}{P_1X_1 + P_2X_2} < 0 \tag{8.8}$$

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

$$P_1X_1 + P_2X_2 = \frac{(\alpha_2-\alpha_1)(1+\tau)\zeta PD - \tau wL}{(1-\alpha_1)-(1+\tau)(1-\alpha_2)} \tag{8.9}$$

Using the expressions for X_1 and D_1, we have

$$sx = \frac{wL - PD[(1-\alpha_2)(1+\tau)\zeta + \omega((1-\alpha_1)-(1+\tau)(1-\alpha_2))]}{(\alpha_2-\alpha_1)(1+\tau)\zeta PD - \tau wL} \tag{8.10}$$

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

$$\frac{wL}{PD} = \frac{sx(\alpha_2-\alpha_1)(1+\tau)\zeta + (1-\alpha_2)(1+\tau)\zeta + \omega((1-\alpha_1)-(1+\tau)(1-\alpha_2))}{1+sx\tau} \tag{8.11}$$

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

$$\overline{Y} = \frac{wL}{P}\frac{(\alpha_2-\alpha_1)(1+\tau)\zeta\kappa^{-1}-\tau}{(1-\alpha_1)-(1+\tau)(1-\alpha_2)} \tag{8.12}$$

In the initial steady state, the consumption is given by $C = D - \frac{I}{P}$, and the investment is given by $I = \delta K = \frac{\delta}{r}(\alpha_1 P_1 X_1 + \alpha_2 P_2 X_2)$. From the determination of sectoral output, we have

$$I = \frac{\delta}{r}\frac{(1+\tau)(\alpha_2-\alpha_1)\zeta PD - (1+\tau)(\alpha_2-\alpha_1)r^*B - (\alpha_2(1+\tau)-\alpha_1)wL}{(1-\alpha_1)-(1-\alpha_2)(1+\tau)} \tag{8.13}$$

For simplicity, we rewrite it as

$$\frac{I}{P} = \phi D + \Phi \tag{8.14}$$

where

$$\phi = \frac{\delta}{r}\frac{(1+\tau)(\alpha_2-\alpha_1)\zeta}{(1-\alpha_1)-(1-\alpha_2)(1+\tau)} > 0 \tag{8.15}$$

$$\Phi = -\frac{\delta}{rP}\frac{(1+\tau)(\alpha_2-\alpha_1)r^*B + (\alpha_2(1+\tau)-\alpha_1)wL}{(1-\alpha_1)-(1-\alpha_2)(1+\tau)} \tag{8.16}$$

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

$$\overline{C} = D[(1-\phi) - \frac{\Phi}{D}] \tag{8.17}$$

where

$$\frac{\Phi}{D} = -\frac{\delta}{r}\frac{\alpha_2(1+\tau)-\alpha_1}{(1-\alpha_1)-(1-\alpha_2)(1+\tau)}\frac{wL}{PD} \tag{8.18}$$

Finally, we obtain the initial consumption as below:

$$\overline{C} = \frac{wL}{P}[\frac{1-\phi}{\kappa} + \frac{\delta}{r}\frac{\alpha_2(1+\tau)-\alpha_1}{(1-\alpha_1)-(1-\alpha_2)(1+\tau)}] \tag{8.19}$$

8.3 Steady State Equilibrium with Credit Constraint

$$B = \frac{1}{\psi_b P}\frac{r^* - r^C + \delta}{1 + r^C - \delta} \tag{8.20}$$

$$(\frac{w}{A_1})^{1-\alpha_1} r_1^{\alpha_1} = P_1^* \tag{8.21}$$

$$(\frac{w}{A_2})^{1-\alpha_2} r_2^{\alpha_2} = (1+\tau)P_2^* \tag{8.22}$$

$$\frac{K_1}{K_2} = \frac{\mu_k}{1-\mu_k} \tag{8.23}$$

$$L_1 + L_2 = L \tag{8.24}$$

$$r_1 K_1 = \alpha_1 P_1 X_1 \tag{8.25}$$

$$r_2 K_2 = \alpha_2 P_2 X_2 \tag{8.26}$$

$$wL_1 = (1-\alpha_1)P_1 X_1 \tag{8.27}$$

$$wL_2 = (1-\alpha_2)P_2 X_2 \tag{8.28}$$

$$r^C = \mu_k K_1 + (1-\mu_k)K_2 \tag{8.29}$$

$$P_1 D_1 = \omega P D \tag{8.30}$$

$$P_2D_2 = (1-\omega)PD \tag{8.31}$$

$$D = C + \frac{\delta(K_1+K_2)}{P} + \frac{\psi_b}{2}B^2 \tag{8.32}$$

$$P_1X_1 + P_2X_2/(1+\tau) + r^*B = \zeta PD \tag{8.33}$$

$$\frac{C}{Y} = \frac{\overline{C}}{\overline{Y}}[\beta(1+r^C-\delta)]^{\frac{1}{\psi}} \tag{8.34}$$

Table 1: Episodes of Trade Reforms (1990-2010)

Country Name	Period	Tariff Change (Simple Average)	Tariff Change (Weighted Average)	Imports Change
Albania*	2001-2002	-3.21	-2.93	8.01
Algeria*	2001-2003	-3.44	-3.19	3.8
Bangladesh*	2003-2005	-4.21	0.86	3.01
Bangladesh	2006-2007	-0.72	-8.62	3.51
Belize	1999-2001	-9.18	-0.48	6.31
Bhutan	2005-2007	-0.24	-5.01	4.27
Brazil*	1989-1993	-30.01	-18.9	3.63
Brazil*	1998-2001	-1.76	-5.52	4.56
Cambodia*	2003-2005	-2.14	-5.54	4.35
Canada*	1995-1997	-3.3	-2.34	3.4
China*	1992-1997	-24.57	-16.35	4.86
China*	2001-2003	-4.52	-7.63	6.88
Georgia*	2002-2004	-3.1	-1.33	4.02
Guyana	1999-2001	-9.73	-3.59	6.14
India*	2004-2008	-16.86	-16.55	4.93
Indonesia*	1989-1990	-3.48	0.36	3.55
Indonesia*	1995-1996	-2.99	-3.16	15.57
Indonesia*	1999-2001	-4.3	-1.74	3.03
Kenya*	2004-2006	-4.11	-3.44	3.1
Kyrgyz Republic*	2002-2003	-3.33	-2.52	7.92
Lebanon	2000-2001	-8.72	-8.69	4.01
Lesotho	2006-2007	0.05	-3.04	5.22
Malawi*	1996-1998	-6.67	-4.37	6.23
Mauritius*	1995-1997	-0.99	-4.91	3.19
Mauritius*	2005-2006	-2.96	-3.5	7.05
Morocco*	2006-2009	-6.13	-4.61	5.19
Nigeria*	2001-2002	3.9	-3.02	8.15
Pakistan	2001-2003	-3.01	-3.43	3.85
Paraguay*	2004-2006	-1.91	-5.21	5.6
Peru*	2006-2008	-4.11	-4.04	7.23
Philippines	1989-1990	-8.68	-7.66	3.02
Seychelles*	2005-2006	-3.64	-0.45	4.13
St Lucia*	2000-2001	-9.76	-4.25	4.16
Syrian Arab Republic	2009-2010	0	-4.03	4.61
Thailand*	1993-1995	-22.66	-21.7	6.39
Thailand*	2003-2005	-3.46	-4.15	6.94
Tunisia*	2002-2008	-12.4	-10.46	3.36
Zimbabwe	1996-2003	-25.1	-22.45	8.67

Note: * denotes countries for which data on current account and capital intensity are also available.

Table 2: Changes in Current Account and Changes in Trade Policy, 1990-2010

Dependent variable = Δ (CA/GDP)

	(1)	(2)
ΔK-Intensity	-61.69*	-139.77*
	(30.26)	(63.12)
ΔRER		-0.08*
		(0.04)
Constant	-0.82*	-1.93**
	(0.43)	(0.77)
# of Observations	28	13

* indicates significant at 10% level, ** 5% level, *** 1% level

Table 3: Summary of Parameters Used in the Calibrations
(In the text)

Table 4: Steady States Before and After a Tariff Reduction

Variable	Benchmark (No Credit Constraint)			With Credit Constraint		
	tariff=0.15	tariff=0.1	tariff=0.05	tariff=0.15	tariff=0.1	tariff=0.05
(1)	(2)	(3)	(4)	(5)	(6)	(7)
r^c	0.0351	0.0324	0.0298	0.0351	0.0342	0.0336
r_1	0.0351	0.0324	0.0298	0.0351	0.0357	0.0370
r_2	0.0351	0.0324	0.0298	0.0351	0.0331	0.0312
w_1	28.038	29.172	30.408	28.038	27.802	27.31
w_2	28.038	29.172	30.408	28.038	27.802	27.31
P_1	3.5882	3.5882	3.5882	3.5882	3.5882	3.5882
p_2	0.3205	0.3066	0.2926	0.3205	0.3066	0.2926
P	1.0724	1.0488	1.0247	1.0724	1.0488	1.0247
C	8.356	8.457	8.477	8.3575	8.289	8.1641
D	12.536	13.052	13.412	12.549	12.538	12.366
B	0	3.8497	7.5797	0	1.3129	2.0814
K	179.32	192.57	201.49	179.81	178.23	172.17
I	4.483	4.8141	5.0372	4.4951	4.4558	4.3043
Y	12.351	12.841	13.210	12.366	12.379	12.258
K_1	75.648	87.886	104.18	75.518	74.858	72.312
K_2	103.67	104.68	97.315	104.29	103.38	99.86
L_1	0.1923	0.1981	0.2071	0.1920	0.1952	0.1991
L_2	0.0556	0.0498	0.0408	0.0560	0.0527	0.0489
X_1	2.2424	2.4037	2.6191	2.2386	2.2575	2.2612
X_2	16.221	15.798	14.143	16.317	15.927	15.197
D_1	1.8733	1.9075	1.915	1.8753	1.8324	1.7657
D_2	20.973	22.327	23.483	20.995	21.448	21.652
NX_1	1.3245	1.7806	2.5263	1.3038	1.5255	1.7778
NX_2	-1.5232	-2.0014	-2.733	-1.4994	-1.6926	-1.8888
CA/GDP	0	0	0	0	0	0
sx	0.1	0.1322	0.1866	0.0983	0.1175	0.1415
sm	-0.115	-0.1486	-0.2019	-0.1131	-0.1304	-0.1504
B/GDP	0.0%	28.6%	56.0%	0.0%	10.1%	16.6%
TV/GDP	21.5%	28.1%	38.9%	21.1%	24.8%	29.2%
C/GDP	67.7%	65.9%	64.2%	67.6%	67.0%	66.6%
I/GDP	33.8%	35.7%	37.2%	33.9%	34.3%	34.3%

Figure 1: Chinese Tariff Rates and Current Account around Its WTO Accession (1998-2010)

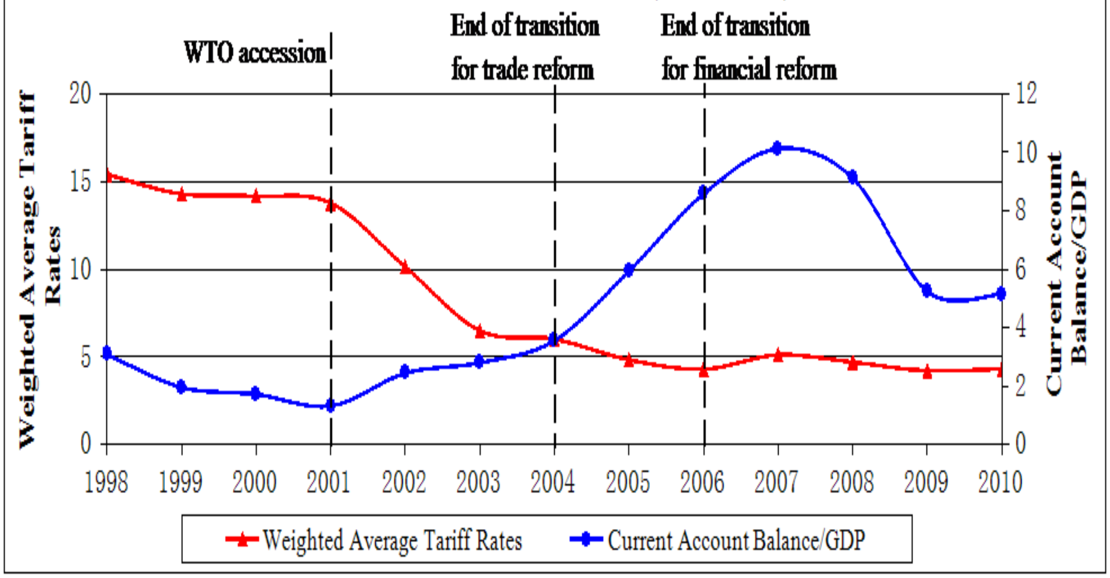

Figure 2: Scatter Plot of Delta CA/GDP vs Delta k-intensity (from t-1 to t+1): Major Trade Policy Changes around the World (1990-2010)

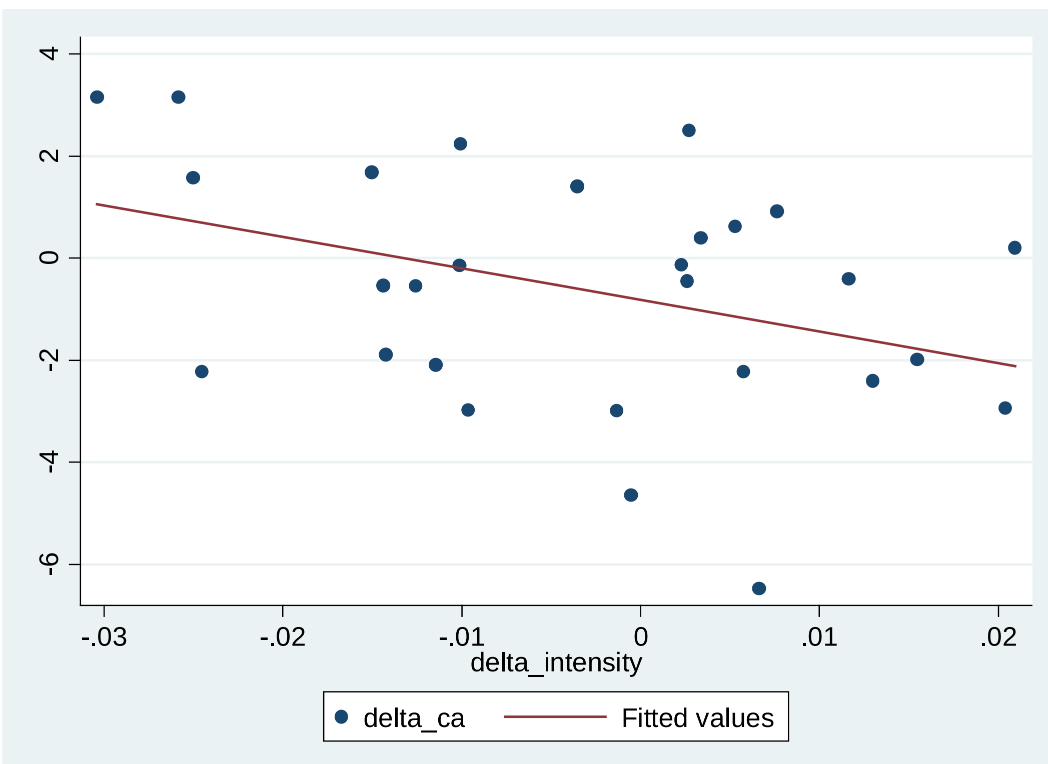

Figure 3: Transition Path of the Economy after a Tariff Reduction by 5 Percentage Points (from 15% to 10%)

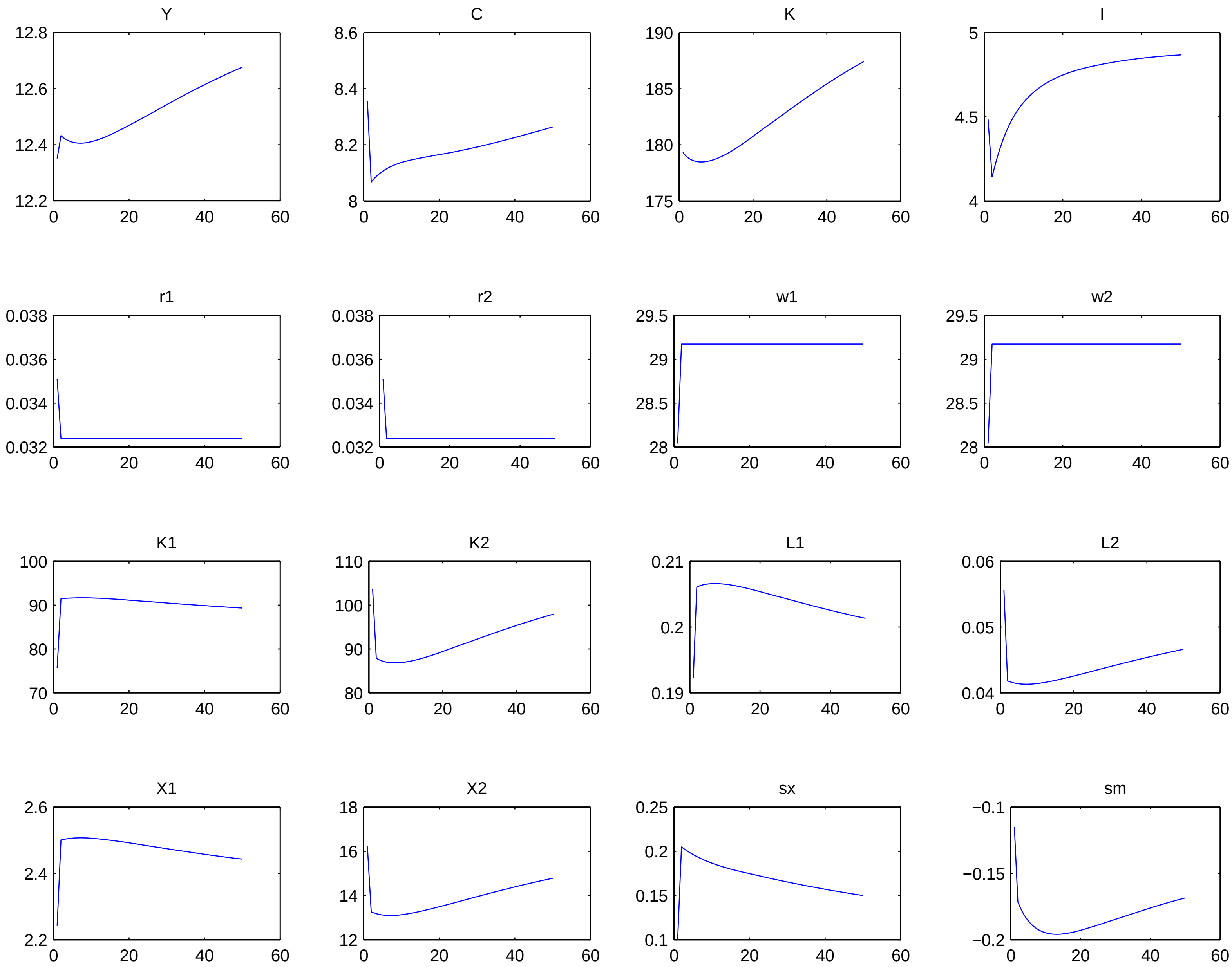

Figure 4: Dynamic Responses of Trade Volume and BOP Variables to a Tariff Reduction by 5 Percentage Points (from 15% to 10%)

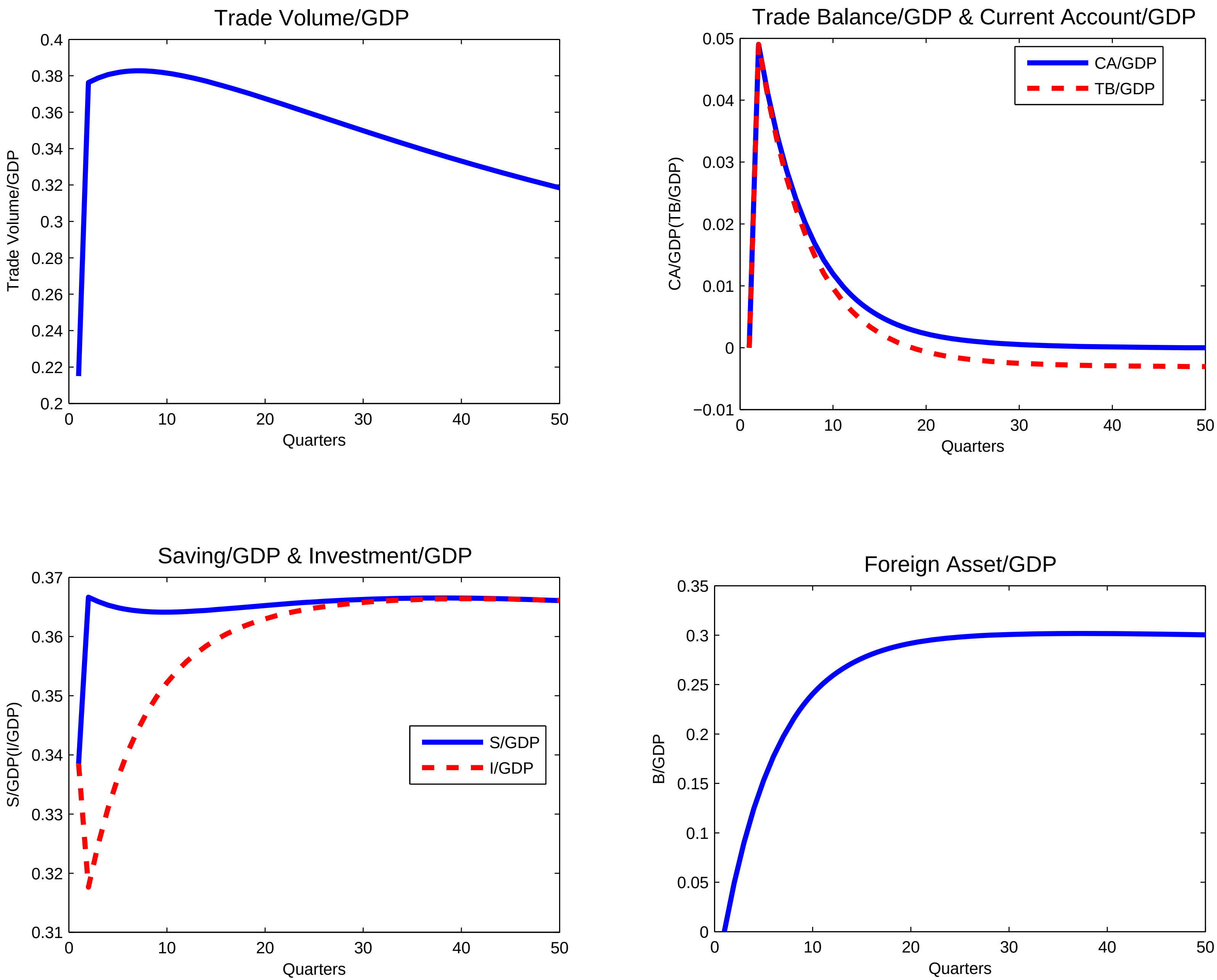

Figure 4A: Dynamic Responses of Trade Volume and BOP Variables to 5% Tariff Cut and 2% Export Cost Cut

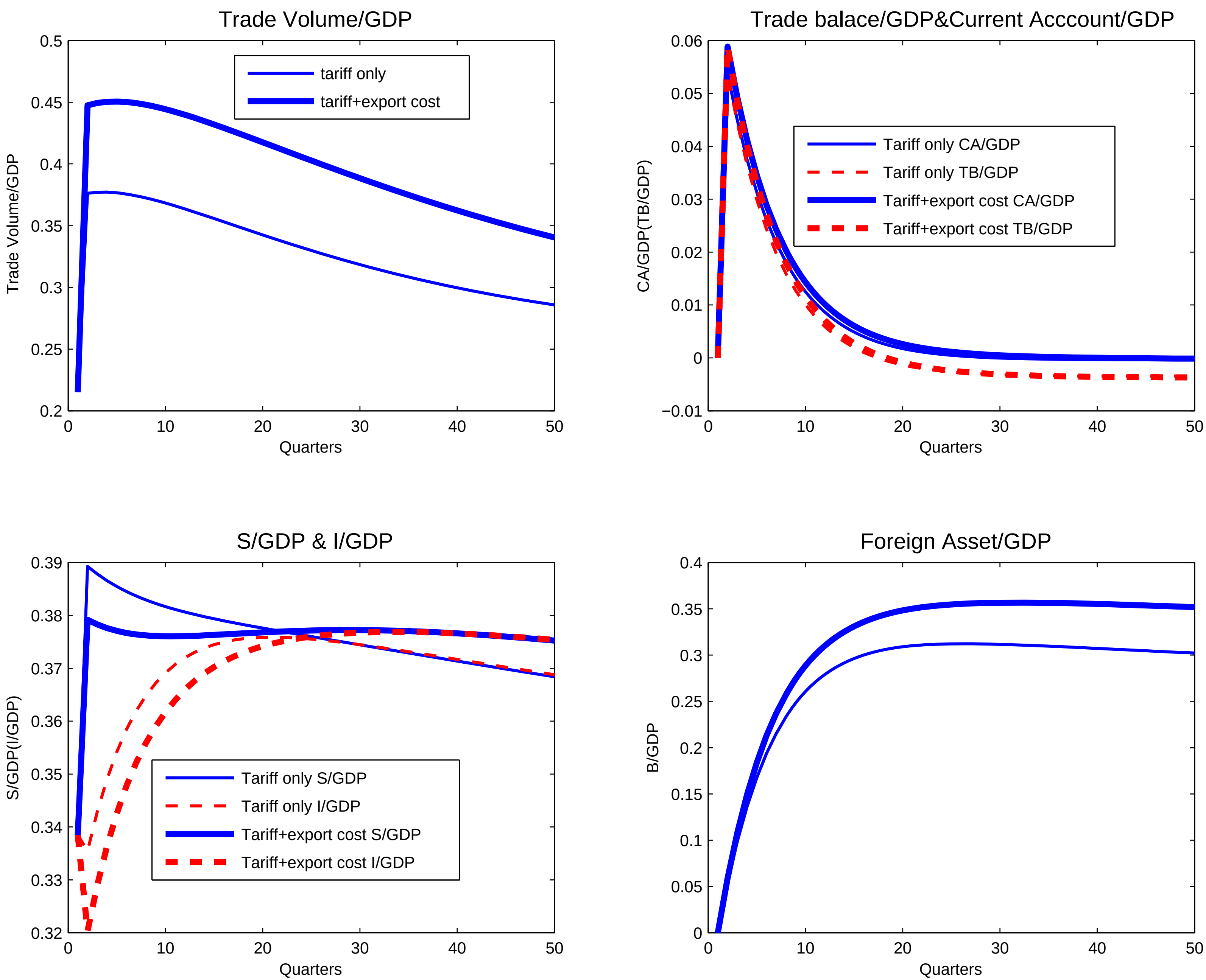

Figure 5: Transition path for different adjustment costs

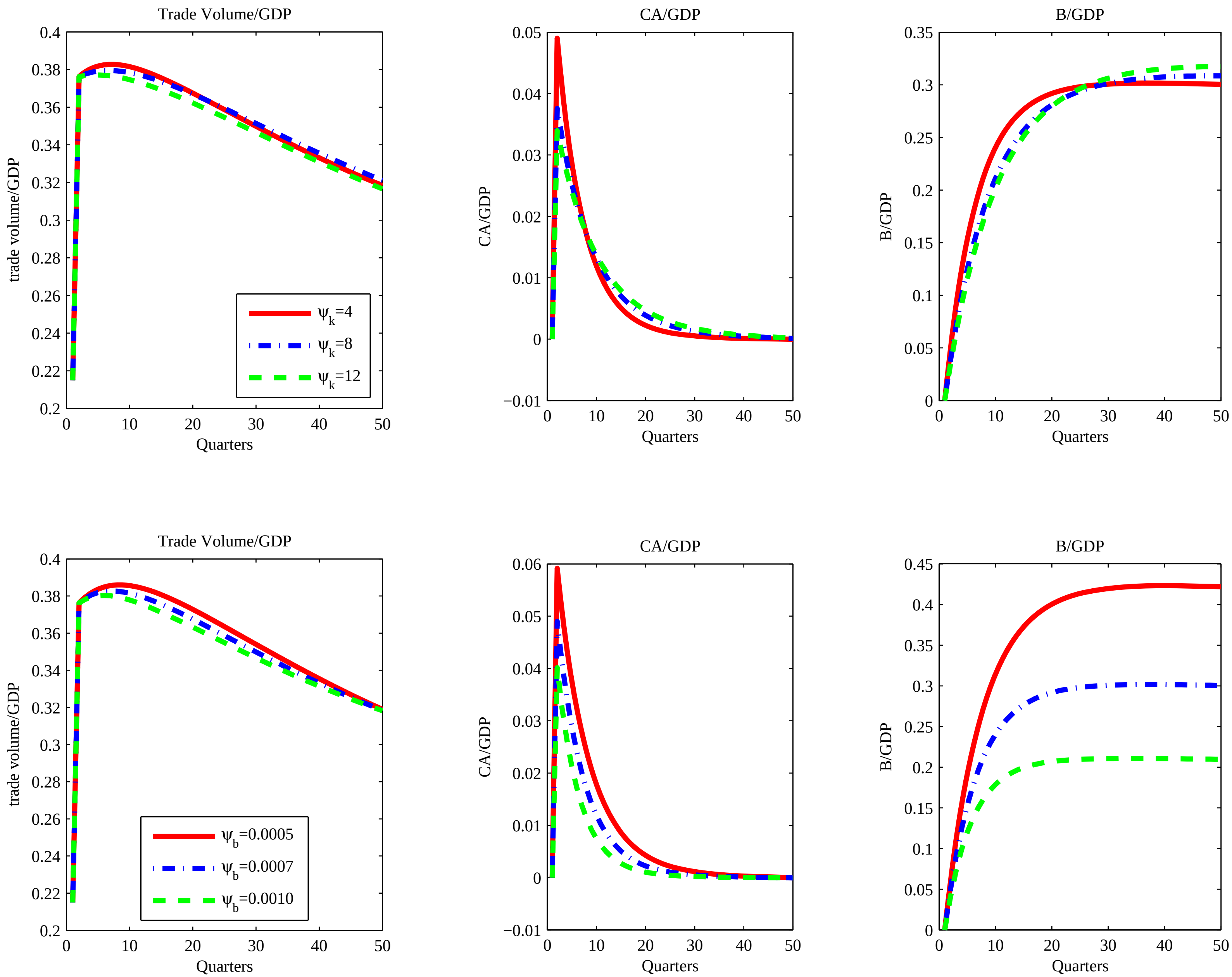

Figure 6: Transition Path under Credit Constraints after a Tariff Cut by 5 Percentage Points (from 15% to 10%)

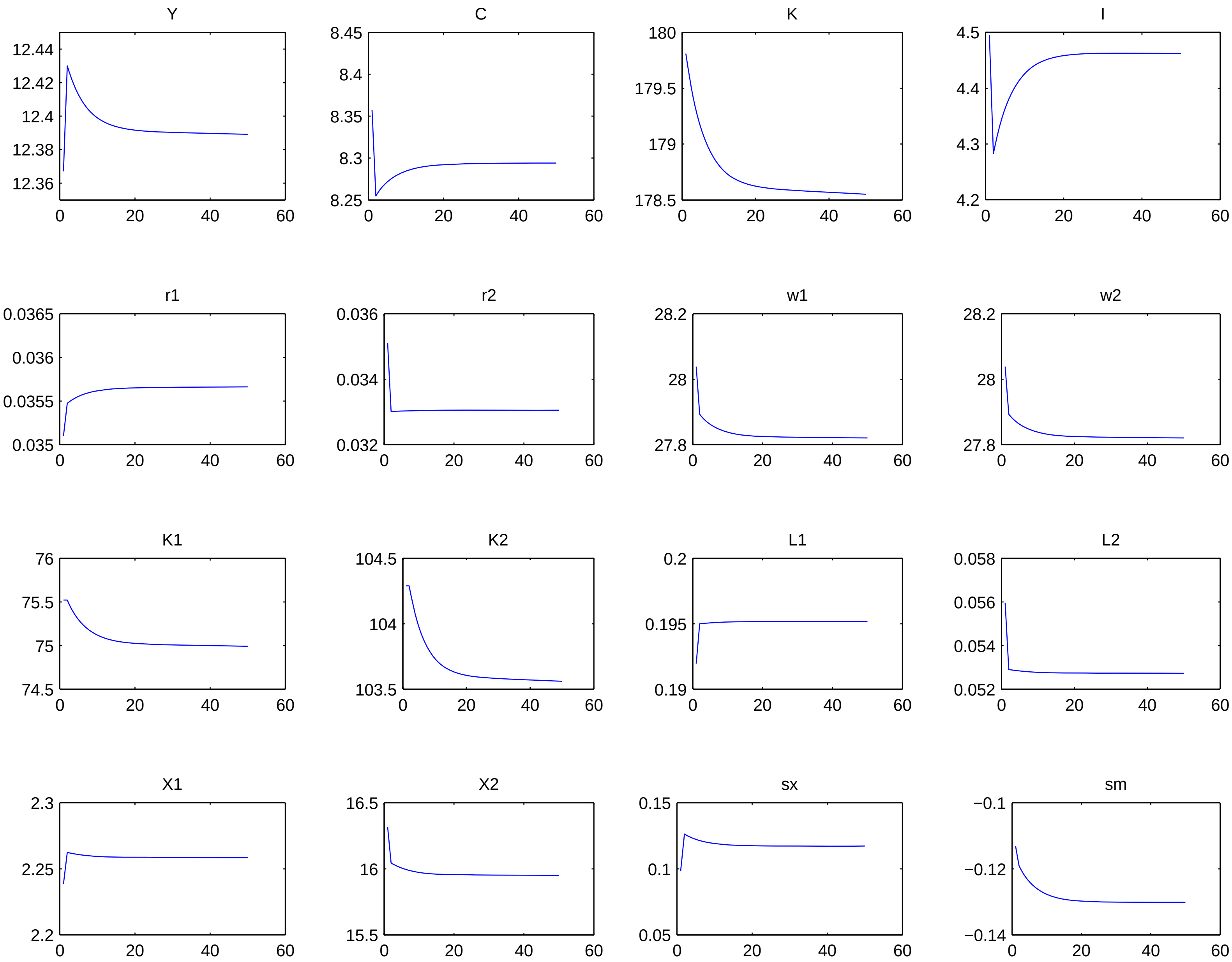

Figure 7: Responses of BOP Variables with and without Credit Constraints to a Tariff Cut by 5 Percentage Points (from 15% to 10%)