Nonlinear bilateral trade balance-fundamentals nexus: A panel smooth transition regression approach

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ABSTRACT

This paper investigates the threshold effects on the impacts of fundamentals (i.e., incomes, exchange rates, oil prices, and import-weighted distances) on China's trade balances with the G7 countries between 1975 and 2010 by using a panel smooth transition regression (PSTR) model with the transition variable of lagged real interest rate differential. The empirical results show that the relationship between the trade balance and the fundamentals is rather nonlinear, changing over time and across countries depending on the lagged real interest rate differential during the different regimes. Moreover, China's bilateral trade balance responds significantly to the changes in relative real income differentials, real oil prices, and import-weighted distance. If the Federal Reserve adopts an expansionary monetary policy in the near future, China would still accumulate higher bilateral trade surpluses from most of the G7 countries, as long as the following situations exist: an increase in China's relative real per capita income, a slow increase in real oil price, and a stable RMB (the Chinese currency) exchange rate system.

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1. Introduction

Three chief developments have dominated the international economic landscape since 2000. The first is the persistence of the great global trade imbalances. For example, China has faced a trade surplus since 1994. The trade surplus amounted to 5.4 billion US dollars in 1994 and 155.1 billion US dollars in 2011. Consequently, there is now an active debate among the G20 countries regarding the desirability of placing limits on the scale of external deficits. The second development is the sharp volatility in oil prices. For example, the West Texas Intermediate crude spot price increased rapidly from approximately 54.43 US dollars per barrel in 2007.1 M to 133.88 US dollars per barrel in 2008.6 M, and then quickly decreasing to 39.18 UD dollars per barrel in 2009.2 M. From then on, oil prices have increased rapidly, reaching 110.06 US dollars per barrel in 2011.4 M. The last development is indicative of the high volatility of the exchange rates. For example, the Chinese yuan appreciated against the US dollar and the Japanese yen by more than 18% between 2000 and 2010. Meanwhile, the European Euro has depreciated by approximately 5%.[1] These three developments not only have disturbed the stabilization of international financial markets, but they have depressed the growth rate of the world economy.

Regarding these three disturbances, Edwards (2006) argued that large external imbalances have posed the most serious macroeconomic risks. Thus, the issue of what drives trade imbalances at the country level has been one of the longest standing themes in international finance. China, the largest export and the second largest import country in the world, has accumulated

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[1] In the early periods of the euro, the depreciation of the nominal exchange rate of the euro against the US dollar in the early periods of the euro is obvious. Since 2002, nominal euro exchange rate has actually regained its value. However, the appreciation situation of euro exchange has changed since 2008. Even for the real euro exchange rate against the US dollar has depreciated 8.14% during the period 2008–2011.

huge trade surpluses between 1994 and 2011, which has evidently significantly influenced the imbalance of global trade in recent years. Nevertheless, a turning point of China's overall trade surpluses occurred in 2008. That is, the accumulation rate of overall trade surpluses before 2008 was less than it was after 2008, and the overall trade surplus in 2008 peaked at 298.12 billion US dollars. Thus, the dynamic path of overall or bilateral trade balances in China might display a nonlinear form, and the questions regarding how to demonstrate the phenomenon, what factors drive this dynamic process, and whether monetary policies can influence the great trade imbalances will be resolved in this paper.

In fact, the *gravity model* of a bilateral trade balance, pioneered by Tinbergen (1962), provides a useful foundation for answering these questions.[2] The standard *gravity model* of trade states that the volume of trade between pairs of countries is a function of the countries' per capita incomes, their geographical distances, and their real exchange rates. After this pioneering work, many studies performed empirical studies to verify the *gravity model* (Bénassy-Quéré & Lahrèche-Révil, 2003; Khan & Hossaian, 2010; Thorbecke, 2006). They have verified that the effects of the real exchange rate and the import-weighted distance on bilateral trade balances are negative. However, the effect of real per capita income is ambiguous. If a partner country demands more of her domestic goods due to higher relative real per capita income, i.e., a higher per capita income differential, the effect of relative real per capita income on trade balance would be negative. On the contrary, if she demands more of the home country's goods due to this increase in income, the effect will be positive.

Though the generalized *gravity model* has provided a good basis for estimating the bilateral trade balances of pairs of countries, there are still some constraints that can be improved as applications are employed, especially with respect to evaluating and demonstrating China's bilateral trade balances. First, most of the previous studies have employed the model by using a linear specification in the cross-sectional or time series context. However, in the commodity and financial markets, factors such as transaction costs (Cheng & Wu, 2013; Imbs, Mumtaz, Ravn, & Rey, 2003), the heterogeneity of traders (Cheng & Wu, 2013; Taylor & Allen, 1992), and the speculative attacks on currencies (Flood & Marion, 1999) all make the time series variables or the relationship between time series variables display a nonlinear, not a linear, path. In addition, Hsiao (2003) has already indicated that in the presence of cross-sectional heterogeneity, assuming a common impact of a variable on a specific variable within international panels may be misleading. One solution dealing with the nonlinearity and heterogeneity problems is to specify a panel smooth transition regression (PSTR) model that was recently developed by Gonzalez, Teräsvirta, and van Dijk (2004), Fok, van Dijk, and Franses (2004), and González, Teräsvirta, and van Dijk (2005). The PSTR model assumes that the behavior of the series changes depending on the value of the transition variable and allows for smooth changes in cross-sectional correlations, cross-section heterogeneity, and time instability of the impact.[3] Thus, the PSTR specification of the bilateral trade balance is a proper method for evaluating the nonlinear dynamics of bilateral trade balances and the nonlinear relationship between bilateral trade balances and their determinants in China.

Second, the transport cost in the generalized *gravity model* is measured only by the absolute distance or import-weighted distance of pairs of countries (Khan & Hossaian, 2010; Kristjánsdóttir, 2005). However, this treatment ignores the role of the changes in oil prices and transport costs of a country's imports. As described in Anderson and van Wincoop (2004), oil prices represent the shipping costs of trade, which lead to higher trade costs and slower trade growth. Thus, the movement of oil prices has often been viewed as a source of a number of economic disturbances, including the slowdown in productivity and trade (see, for example, Baier & Bergstrand, 2001; Bergoeing & Kehoe, 2003; Blanchard, Giavazzi, & Sá, 2005; Obstfeld & Rogoff, 2005). In other words, this paper simultaneously adopts oil prices and import-weighted distance to measure the transport costs of a country's imports. The treatment provides not only a more accurate measure of transport cost, but the evaluation of the impact of oil price changes on the trade balance.

Third, employing a traditional linear *gravity model* of trade cannot evaluate the threshold effects of a monetary policy on the impact of economic determinants on trade balance, i.e., the marginal effects of macroeconomic fundamentals on trade balance vary according to monetary policy variables at different regimes and at different times. According to the *J*-curve hypothesis, an expansionary monetary policy initially causes a trade deficit and then leads to a trade surplus (Kim, 2001; Lee & Chinn, 2006). In addition, different change rates of the monetary supply would cause differential effects on the impact of economic fundamentals on the trade balance. Thus, the monetary policy will give rise to threshold effects on trade balances. To assess this threshold effect, the monetary policy variable as the transition or threshold variable in the PSTR specification of the *gravity model* of trade is a proper tool as the impacts of the explanatory variables on the dependent variable vary with the transition variable at different regimes. However, as explained by Fouquau, Hurlin, and Rabaud (2008), the transition variable in the PSTR model may have a direct effect on the dependent variable (i.e., the trade balance, in this paper). In this case, one could misleadingly find switching. To avoid this probable shortcoming and satisfy the lagged effects of the monetary policy on trade balance in practice, we replace the current transition variable used by previous studies (Colletaz & Hurlin, 2006; González et al., 2005) with a lagged transition variable to conduct the estimation of the PSTR specification of the *gravity model* of trade.

In sum, the aim of this paper is to modify the *gravity model* of trade for evaluating the impact of main macroeconomic determinants, including incomes, exchange rates, oil prices, and import-weighted distance, on bilateral trade balances by employing the PSTR specification. In performing empirical estimations, we adopt the bilateral trade balances of China with the G7

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[2] Anderson (1979) gave a theoretical foundation for the *gravity equation*. Feenstra (2004) provided a systematic explanation of the gravity model. Bahmani-Oskooee and Brooks (1999) supported that it is better to investigate the relationship between trade and exchange rates on bilateral basis to exclude the aggregation bias problem. For example, the existence of the *J*-curve effect may be attributed to the aggregation bias.

[3] They have introduced dynamic nonlinear panel models through the development of PLSTAR (panel logistic smooth transition autoregressive) models. For more details and discussions on the utility of PSTR models, see, for example, Colletaz and Hurlin (2006) and Fouquau et al. (2008).