# The Dual Impact of Exchange Rate Fluctuations on Trade Balance and Global Value Chains: An Empirical Analysis from Short-Term and Long-Term Perspectives

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Abstract: This paper studies the role of exchange rate movements in affecting both trade balance and global value chains (GVCs), both in the short term and the long term. By conducting econometric exercises and using a sample of 30 countries (including the United States, Germany, China and India), we explore how exchange rate volatility affects trade flows and the organisation of global production networks. In the short term, a sudden currency event can lead to large trade imbalances, especially in import-intensive industries, and the use of hedging instruments can help to mitigate these assets risks. In the longer term, sustained currency changes impact deeper structural adjustments of GVCs. Firms tend to relocate production or change their sourcing strategy, in order to reduce exposure of GVCs to exchange rate risks. Overall, the results of our study point to the complexity of the relationship between the currency movement and global trade. From a business perspective, both shortterm risk management and long-term structural adaptation are important to mitigate the potential exchange rate risk for a firm. From a policymaking perspective, understanding the dynamics of exchange rate and currency movements can help to foster the adjustment of global trade with sustainability. The study is particularly relevant for the industries that are most deeply embedded in GVCs, such as electronics and automotive manufacturing.

*Keywords:* Exchange rates, trade balance, global value chains, short-term volatility, long-term adjustments.

### 1. Introduction

Exchange rates are a key driver of international trade and the world economy more generally. A country's exchange rate determines its relative goods and services prices in world markets, thereby affecting its trade balance (whether it exports more or less than it imports). A currency devaluation will typically serve to lower export prices and raise import costs, improving export competitiveness and discouraging imports. A currency appreciation will, by contrast, tend to raise export prices and discourage exports, thereby potentially leading to trade deficits. The relationship between exchange rates and trade balance, however, is complex and depends on a host of factors: the elasticity of demand for exports and imports; the timing and extent of the currency adjustments; etc. Rapid currency swings can still create uncertainty in the short term, disrupting trade flows and earnings for firms engaging in international trade. In the short term, the impact of currency swings tends to be greater in import-

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dependent sectors such as electronics and automotive production, where imports account for a significant proportion of value added. Hedging strategies (for example, forward contracts) can mitigate some of these risks, but their cost and effectiveness vary over time and countries. Over the longer term, persistent exchange rate changes may cause firms to restructure their organisation of production and sourcing activities, with a depreciation encouraging firms to increase the share of exports and localise production, whereas an appreciation would induce firms to relocate production to low-cost locations [1]. These shifts would likely have important consequences for the structure of global value chains (GVCs), as firms reorganise their supply chains, in an effort to mitigate the risks from currency movements.Our goal is to investigate the short- and long-term effects of exchange rate movements on trade balance and GVCs, using empirical data and econometric models to shed light on the mechanisms through which movements in currencies shape global trade outcomes.

## 2. Theoretical Background on Exchange Rates and Trade Balance

## 2.1. Exchange Rate Mechanisms and Trade Balance

Exchange rates represent the relative price of one currency compared with another. This is critical for the price competitiveness of a country's goods and services in international markets. A depreciation of the domestic currency will generally decrease the relative price of a country's exports, making them more attractive to foreign buyers, while at the same time raising the price of imports, which can limit demand for foreign goods. Meanwhile, an appreciation of the currency will make exports more expensive and imports cheaper – potentially creating a trade deficit. There is, however, no straightforward relationship between exchange rates and trade balance. The so-called 'J-curve' effect refers to the fact that a depreciation of the currency might initially worsen a trade balance due to higher import prices, before improving it as export volumes increase in response to the lower relative prices [2]. The elasticity of demand for exports and imports, the structure of the economy, and the timing of exchange rate adjustments all help determine the net impact of currency fluctuations on trade. Exchange rates also have a number of macroeconomic determinants – interest rates, inflation and government intervention in the foreign exchange market – which help explain their behaviour. To understand the broader implications of exchange rate fluctuations on trade balance, it is important to grasp these mechanisms.

### 2.2. Short-Term Impact of Exchange Rate Volatility on Trade Flows

In the short run, exchange rate volatility can have immediate and often disruptive consequences for trade flows. Sharp fluctuations in exchange rates can increase uncertainty and risk for international trading firms, leading to volatility in earnings and cost structures. For exporters, sudden swings in exchange rates can lead to a reduction in demand for goods as they become suddenly more expensive for foreign consumers, while importers may face a spike in cost for domestic goods following a depreciation of the domestic currency. Such volatility can lead to short-term imbalances in trade, as firms struggle to adjust prices and manage currency risks. Furthermore, the sectoral impact of exchange rate changes in the short run can be uneven: firms with high input costs, such as firms that rely heavily on imported inputs, or firms whose products compete on price-sensitive international markets, are often more susceptible to sudden currency shifts [3]. Firms have a variety of tools to help manage short-term exchange rate risks, including forward contracts and currency swaps financial instruments that allow firms to hedge against exchange rate movements. But using these financial tools can be costly, and they may not fully mitigate the impact of rapid currency movements. There is empirical evidence that exchange rate volatility leads to a reduction in trade volumes in the short run, as businesses adopt a 'wait and see' approach, postponing investment or purchasing decisions until exchange rate trends stabilise.

## 2.3. Long-Term Structural Adjustments in Response to Exchange Rate Shifts

While the short-term consequences of exchange rate fluctuations are typically volatile and uncertain, the long-term consequences tend to be more structural. Persistent exchange rate changes can result in deep-rooted changes in the ways in which firms and industries organise their production processes and supply chains. For instance, a sustained depreciation of the domestic currency could induce firms to increase their reliance on exports because their goods become more competitive in foreign markets. Conversely, firms could attempt to lessen their reliance on imported inputs by sourcing these materials and components from other countries that might produce them more cheaply or from regions with more favourable exchange rate conditions. Over time, these adjustments could result in structural changes in the way the world's final goods are produced. These shifts could see the production facilities of some companies re-located to countries with more stable or more favourable exchange rates, or else the supply chains of firms become more diversified as a hedge against exchange rate risks. In addition to exchange rate changes, other structural factors such as trade policies, technological changes and the competitive dynamics within global industries contribute to the long-term impact of exchange rate changes [4]. The long-term consequences of exchange rate shifts stand to have far-reaching consequences for international trade, as they can reconfigure global supply chains and reshape the distribution of economic power among nations.

#### 3. Impact of Exchange Rate Fluctuations on Global Value Chains

#### 3.1. Short-Term Disruptions in Global Value Chains

The panel data regression results in the long-term also show that persistent changes in the exchange rate have greater and more enduring effects on the trade balance and global value chains. Over time, producers adjust their locations of production, sourcing strategy and pricing structure to persistent currency fluctuations. For example, a protracted depreciation of the domestic currency would induce firms to expand their export operations, a consequence of the higher price competitiveness of their goods internationally. Meanwhile, they may also look to domesticating production in response to import-input dependence ('Chokepoint risk') or diversifying the source of inputs to less volatile currencies. To shed light on the long-term adjustment, we conduct a further experiment to investigate the effects of sustained currency fluctuations on global value chains in four major economies: the United States, Germany, China and India. The results of the experiment, displayed in Table 1, confirm that the magnitude of production switching and export competitiveness (captured by changes in the trade balance) depends significantly on the appreciation of currencies and the mitigation of exchange rate risks through hedging and other instruments. For example, the results suggest that countries with higher rates of appreciation of currencies, such as China, are subject to larger shifts in production to low-cost countries, and increases in domestic production capacity, which in turn exert downward pressures on the prices of goods produced in China. The table also shows the mitigating effect of hedging and other risk-management strategies in easing the impact of exchange rate fluctuations [5]. The findings show the distinctive differences across countries in terms of the long-term adaptation strategies to sustain global competitiveness, and highlight the importance of proactive currency risk management.

Country	Currency Appreciation (Annual %)	Shift in Production to Low-Cost	Increase in Domestic Production	Change in Export Competitiveness	Risk Mitigation Through Hedging (Adoption	Overall GVC Adjustment Rate (%)
United States	5.2	15.5	8.4	1.05	65	22.3
Germany	3.1	10.2	12.6	1.03	58	18.5
China	6.4	20.3	7.1	1.08	72	27.4
India	4.5	12.7	10.9	1.04	60	20.8

Table 1. Case	Analysis of	GVC Ada	ntation to	Exchange	Rate Changes
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## 3.2. Long-Term Adaptation of Global Value Chains to Exchange Rate Changes

In the longer term, currency movements can precipitate deeper structural and organisational changes in GVCs. As GVC firms contemplate their exposure to currency risks, they are also likely to make organisational adjustments to cope with a volatile global market. For instance, if there is a prolonged domestic currency appreciation, GVC firms might be incentivised to shift some of their production to lower-cost countries with cheaper labour and input costs, and a lower exchange rate. Meanwhile, a prolonged depreciation of the currency could encourage firms to expand their domestic production capacity, as their export goods become more competitive. These strategic adjustments can result in deeper shifts in the global pattern of production and trade as firms seek to optimise their supply chains and reduce their exposure to exchange rate risks [6]. Third, economic and political factors – such as trade agreements, regulatory frameworks and technological innovations – influence the long-term adaptation of GVCs to exchange rate movements. As GVC firms continue to globalise their investment and production activities, and further embed themselves into longer and more complex value chains, their ability to manage exchange rate risks will be an important determinant of their long-term competitiveness in the global market.

# 4. Empirical Analysis of Exchange Rate Fluctuations and Trade Balance

### 4.1. Data Collection and Methodology

To empirically analyse the dual implications of exchange rate fluctuations on trade balance and global value chains, this study adopts a mixture of macroeconomic data from international databases, including the International Monetary Fund (IMF), the World Bank and the United Nations Comtrade database. The sample period is over a period of 20 years, from 2000 to 2020. A set of variables such as bilateral exchange rates, trade volumes, gross domestic product (GDP), inflation rates and key indicators of GVC participation are used. An econometric model is adopted to estimate the short-term relationship between exchange rate volatility and trade balance through implementing the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model, which illustrates the intrinsic volatility in exchange rates [7]. Second, a panel data regression model is used to investigate the long-term structural adjustments in trade balance and GVC configurations, in order to understand how persistent exchange rate changes impact global production and sourcing strategies. The selection of models is based on the assumption that exchange rates are volatile and persistent, so that the empirical estimation results could capture the immediate and sustained implications of exchange rate fluctuations on trade flows and GVCs.

# 4.2. Short-Term Impact: Empirical Results

That exchange rate volatility has a statistically significant causal effect on the trade balance of importintensive industries is suggested by our short-term analysis. Our GARCH model shows that exchange rate volatility serves as a source of uncertainty in trade, and, as a result, temporarily leads to trade imbalances. A domestic-currency depreciation is likely to cause a temporary worsening of the trade deficit. The immediate increase in import costs due to exchange rate fluctuations tends to outweigh associated benefits of enhanced competitiveness in exports. We find that this effect is stronger for countries with relatively low export elasticity, or low responsiveness of foreign demand for domestic exports to changes in relative prices [8]. In contrast, the trade balance of countries with relatively higher export elasticity reacts relatively more favorably, as foreign consumers are likely to respond rapidly to lower export prices. In order to verify these two effects in an empirical manner, we conducted an experiment on real-world trade data in over 30 nations, including the US, Germany, China and India using various metrics such as the short-run export elasticity, trade deficit changes after currency depreciation and sectoral sensitivity to currency fluctuation in electronics and automotive industry. Specifically, we highlight key findings in Table 2 which illustrates how US industrial gateway suppliers in electronics and automotive manufacturing have grown more sensitive to short-term exchange rate volatility due to a high reliance on imported intermediate goods. We also find that countries that are adopting higher hedging rates such as Germany and the US tend to be more effective in managing short-term currency risk compared with others [9].

Country	Export Elasticity (Index)	Increase in Trade Deficit (%, After Depreciation)	Improvement in Export Competitiveness (Index)	Sector Sensitivity to Exchange Rate (Electronics)	Sector Sensitivity to Exchange Rate (Automotive)	Hedging Adoption Rate (%)
United States	0.72	3.5	1.04	9.5	8.7	68
Germany	0.85	2.1	1.06	7.8	7.5	72
China	0.68	4.8	1.03	10.2	9.1	63
India	0.79	3	1.05	8.3	7.9	58

Table 2: Short-Term Impact of Exchange Rate Volatility on Trade Balance

# 4.3. Long-Term Impact: Empirical Findings

The long-term analysis of the panel data regression results reveals that sustained exchange rate changes have stronger and longer-lasting effects on trade balance and GVCs. Over time, firms tend to make structural adjustments in their production locations, sourcing and pricing strategy as a response to persistent currency fluctuations. For example, a persistent currency depreciation would lead firms to expand their export activities, taking advantage of the competitive prices of their goods in international markets. At the same time, firms could also try to reduce the share of imported inputs in their production processes by localising production or diversifying their supplier base to regions with more stable currencies [10]. These structural adjustments over time tend to improve trade balance as firms become more resilient to exchange rate risks. The long-term analysis also shows that exchange rate fluctuations have differential impacts on countries at different stages of GVCs. Developing countries, which are usually located at the lower end of the GVC, are less capable of adjusting to exchange rate changes due to low access to financial and technological resources. By contrast, developed countries, which usually have more advanced manufacturing capabilities and more diversified supply chains, are better able to cope with the risks brought about by exchange rate fluctuations.

## 5. Conclusion

This study provides a holistic picture of the asymmetric effects of exchange rate fluctuations through trade balance and global value chains, in the short term and the long term. In the short run, exchange rate volatility tends to cause temporary trade deficits, especially in industries highly dependent on imported inputs. With the help of hedging and other risk-mitigation tools, empirical data from various countries indicate that exchange rate volatility could be circumvented. In the long run, sustained currency changes could cause structural adjustments in GVCs, pushing firms along the value chains to relocate production and change sourcing strategies to minimise costs and manage currency risks. These findings address the importance of risk management and adaptive strategies for firms operating in the open markets. Policymakers could also consider the impact of exchange rate policies on trade flows and GVCs to enhance the resiliency to currency fluctuations. Future works could further investigate the sectoral differences and the role of technological innovation.

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