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# Institutional Quality and Sustainable Development of Industries' Exports: Evidence from China

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**Abstract:** The knowledge about the relations between domestic institutional quality and the sustainable development of exports in emerging markets remains limited, since most research into the relations between the institutional environment and the sustainable development of exports has been conducted in developed market economies, especially in those of North America and Europe. With dynamic changes in the institutional environment of emerging countries over the years, this paper provides a novel perspective for investigating the relations above. This is the first paper to investigate the impact of institutional quality on the sustainable development of industries' exports in emerging countries from a comprehensive perspective of multiple institutional environments and multi-dimensional industries' heterogeneity. On the basis of defining institutional quality and industry heterogeneity, this paper explores the underlying mechanisms of institutional quality affecting sustainable development of industries' exports and conducts empirical analyses by using the data from China's 20 industries' exports to 117 countries for the period of 1996–2011. The results show that: (a) Industries with higher degrees of financial dependence or higher product technical complexities have export comparative advantages in better financial environments; (b) Industries with higher research and development (R&D) intensity or a higher concentration of intermediate inputs have export comparative advantages in better legal environments; (c) The differences in the level of financial development or in the efficiency of legal system would influence the effects of interactions between institutional quality and industry heterogeneity on the sustainable development of industries' exports. The present paper provides new evidence that institutional quality does promote the sustainable development of industries' exports in emerging countries. These results indicate that exports of heterogeneous industries in emerging economies are an adaptive response to the specific institutional environment, as well as a continuous release of institutional dividends with the improvement of the institutional environment.

**Keywords:** institutional quality; sustainable development; comparative advantage; heterogeneous industries; financial development level; legal system efficiency

## 1. Introduction

To seek the driving forces of the sustainable development of industries' exports is a practical and significant topic for economic scholars and governments. In international markets with rising uncertainty, such as the increasingly fierce Sino–US trade frictions, export volumes of the international market show a sharp decline, and the sustainable development of exports in emerging countries has been confronted with severe challenges. Meanwhile, the role of domestic institutional quality in affecting the sustainable development of exports in emerging countries should be paid more attention, since a recent cluster of work has confirmed institutional sources of comparative advantage, such as

contract enforcement [1–3], financial development [4–6], legal environment [7,8], the flexibility of labor market [9], and the informal institution [10–12]. Moreover, for an emerging country, the formation of new domestic institutional comparative advantages also helps to address the external uncertainty of international markets by constantly enhancing its economic competitiveness. Most research into the relations between the institutional environment and the sustainable development of exports has been conducted in developed market economies, especially in those of North America and Europe. However, knowledge about the relations between the domestic environment quality and the sustainable development of exports in emerging markets remains limited.

In the literature, when conducting research on this topic, most scholars focus on the relations between the institution and trade from the perspective of a specific institution, and emphasize that institutional quality is a key factor affecting industries' or enterprises' export performances [13–15]. One branch of the studies emphasizes the important role of the institution in trade at a macro level. North [16] indicates that institutional performance is a fundamental factor that leads to differentiated economic growth and trade development among different countries. Helpman [14] concludes that the institution is the mystery of economic growth, and that the institution exerts more effects than other factors, such as geography or policy, on a country's trade development. Nunn and Trefler [15] indicate that after decomposing the institution into the formal institution, the informal institution, and policy, domestic institutional sources of comparative advantage do operate through fundamentally different channels, compared with traditional sources of comparative advantage, such as factor endowments. Another group of papers focuses on the related research at the industry level or at the firm level [17,18]. Levchenko [2] proposes a theoretical analytical framework incorporating the variation of incomplete contracts into models and concludes that institutional differences among countries are an important determinant of trade flows. Nunn [19] investigates the different trade patterns of industries with necessary relationship-specific investments of the production process in countries with different contracting environments, and shows that countries with more favorable contract enforcement would specialize in industries that have more heavy dependence on relationship-specific investments. Costinot [20] demonstrates that better institutions are complementary sources of comparative advantage in industries with more complex products. Manova [21] unpacks the three mechanisms through which credit constraints affect trade as follows: heterogeneous firms' selection to domestic production, domestic manufacturers' selection to conduct exporting, and the level of firm exports, and shows that financially developed countries export more in financially vulnerable industries by entering more markets, shipping more products to each destination, and selling more of each product. Álvarez et al. [18] indicate that both the institutional quality of the exporting destination and the institutional distance between trading countries are relevant factors for bilateral trade. Alternatively, there are some other papers deeply exploring the impact of international trade on institutional quality, such as contract enforcement or property rights [22,23]. Levchenko [23] shows that the quality of the institution is determined by the equilibrium of a political economy game, and both trade countries are forced to improve their institutions after opening.

In recent studies, the literature has begun to inspect the role of the institution in trade from more extensive aspects, and it also confirms that institution does matter for trading [24–26]. Beverelli et al. [27] identify the impact of country-specific institutions on international trade by using the structural gravity framework to address the prominent issue of endogenous institutions, and they conclude that a stronger institution promotes trade. Ding et al. [12] observe that the Chinese-style institution has a key foundation in that governments at different levels affect resource flows to firms that are connected to them. After inspecting the relation between this institutional feature and firm exports, they conclude that firms with political connections could achieve comparative advantages in contract-intensive and financially-dependent industries, while political connections also exert a negative effect on firm exports, due to the problem of managerial inefficiency. Castellares and Salas [28] investigate the relation between the institution and trade for importing countries, and demonstrate that an adverse shock for an importing country leads to a disproportional decline in imports in industries

with high degree of contractual vulnerability. Huber [29] examines that the variation in trade pattern affects institutional quality by using data on disaggregated bilateral trade flows around the world. Moreover, some studies focus on the role of the institutional gap between trading partners in trade, and confirm that institutional gap has a negative effect on bilateral trade [18,30,31]. Liu et al. [30] demonstrate that cultural distance and institutional distance inherit the bilateral trade between China and the Belt and Road countries, and Karam and Zaki [31] conclude that the institutional gap, as a fixed cost exerts significantly negative effects on the trade of the countries in the Middle East and North Africa.

However, the studies above only focus on one dimension of institution, such as contract enforcements, and few studies empirically investigate the significant influence of multi-dimensional institutions on shaping trade patterns. Moreover, there are few relevant evidences from emerging countries that are undergoing the changes in domestic institutional environment. North [16] defined the institution as a series of game rules that are divided into the formal system and informal system, as well as the implementation features of the two systems. Referring to the existing literature, such as Demirgüç-Kunt and Maksimovic [32], Levchenko [2], and Manova [21], we choose the framework of the financial system and the legal system to investigate the role of institutional quality in the sustainable development of heterogeneous industries' exports by decomposing industry heterogeneity into four aspects: financial dependence degree, product technology complexity, research and development (R&D) intensity, and the concentration of immediate inputs. On the basis of theoretical analyses, three hypotheses are proposed, and the empirical results are in line with the hypotheses by using the data from China's 20 industries' exports to 117 countries for the period of 1996–2011. The results show that: (a) Industries with a higher degree of financial dependence or higher product technical complexity have export comparative advantages in a better financial environment; (b) Industries with higher R&D intensities or a higher concentration of intermediate inputs have export comparative advantages in better legal environments; (c) The differences in the level of financial development or in the efficiency of the legal system would influence the effects of the interaction between institutional quality and industry heterogeneity on the sustainable development of industries' exports. These results indicate that exports of heterogeneous industries in transition economies are an adaptive response to the specific institutional environment, as well as a continuous release of institutional dividends with the improvement of the institutional environment.

This paper contributes to the literature in the following ways. First, this is the first paper to investigate the impact of institutional quality on the sustainable development of industries' exports in emerging countries from a comprehensive perspective of multiple institutional environments and multi-dimensional industries' heterogeneity. Second, the present paper provides new evidences that institutional quality does promote the sustainable development of industries' exports in emerging countries.

The remainder of this paper is organized as follows. Section 2 presents theoretical analyses and research hypotheses. Section 3 establishes the econometric model and introduces relevant variables and data. Section 4 presents the regression results and their implications. Section 5 presents the regression results of robustness checks. Section 5 concludes and provides some policy implications.

## 2. Theoretical Analyses and Research Hypotheses

In this section, following the analytical framework of Eaton and Kortum [33] and Chor [34], we investigate the synergistic effect of institution quality and industry heterogeneity on the sustainable development of heterogeneous industries' exports. After defining institution quality from the perspective of the financial development level and the legal system efficiency, and decomposing industry heterogeneity into four aspects, namely, financial dependence degree, product technology complexity, R&D intensity, and concentration of immediate inputs, three hypotheses are proposed in this section.

## 2.1. Theoretical Analyses

Following Eaton and Kortum [33] and Chor [34], consider a world with  $N$  countries,  $n = 1, 2, \dots, N$ ,  $K+1$  industries,  $k = 0, 1, \dots, K$ ; the products of industry 0 are non-tradable and homogeneous, and the products of industry 1, 2, ...,  $K$  are continuous, tradable and heterogeneous, marked as  $j^k \in [0, 1]$ . Assume that the producer is in a perfect competitive market and that there is no fixed cost or economies of scale in production. As in Eaton and Kortum [33], the price of product  $j$  that country  $i$  exports to country  $n$  in industry  $k$  could be expressed as:

$$p_{ni}^k(j) = \frac{c_i^k d_{ni}^k(j)}{z_i^k(j)} \quad (1)$$

where  $c_i^k$  is the unit production cost of product  $k$  in the export country  $i$ ,  $z_i^k(j)$  is the productivity of product  $j$  in industry  $k$  of country  $i$ , and  $d_{ni}^k(j) \geq 1$  is the iceberg transport cost of country  $i$  exporting to country  $n$  that is caused by the items, such as spatial distance or political obstacles.

In Chor [34], to unpack the sources of comparative advantage, the log productivity of country  $i$  in industry- $k$  varieties,  $\ln z_i^k(j)$ , can be specified as:

$$\ln z_i^k(j) = \lambda_i + \mu_k + \sum_{\{l,m\}} \beta_{lm} L_{il} M_{km} + \beta_0 \varepsilon_i^k(j) \quad (2)$$

where the indexes have the same meaning as Chor [34], unless giving other statements. In Equation (2), the log productivity,  $\ln z_i^k(j)$ , is composed of the following items: (a) a systematic component,  $\lambda_i + \mu_k + \sum_{\{l,m\}} \beta_{lm} L_{il} M_{km}$ , that has a linear impact on the average log productivity level of industry  $k$  in country  $i$ ; and (b) a stochastic term,  $\beta_0 \varepsilon_i^k(j)$ , that indicates idiosyncratic variation in the productivity across varieties. Moreover, following Chor [34],  $\sum_{\{l,m\}} \beta_{lm} L_{il} M_{km}$  indicates the synergistic effect of institutional quality and industry heterogeneity on the log productivity.

Following Chor [34], normalizing country  $n$ 's expenditure share from country  $i$  with respect to country  $n$ 's expenditure share from a fixed reference country,  $u$ , we have:

$$\frac{X_{ni}^k / X_n^k}{X_{nu}^k / X_n^k} = \frac{X_{ni}^k}{X_{nu}^k} = \left( \frac{c_i^k}{c_u^k} \right)^{-\theta} \left( \frac{d_{ni}^k}{d_{nu}^k} \right)^{-\theta} \left( \frac{\varphi_i^k}{\varphi_u^k} \right) \quad (3)$$

where  $c_i^k / c_u^k$  is the relative production cost of the two countries  $i$  and  $u$ ,  $d_{ni}^k / d_{nu}^k$  is the relative distance of the two countries  $i$  and  $u$  to country  $n$ ,  $\varphi_i^k / \varphi_u^k$  is the relative productivity of the two countries  $i$  and  $u$ , and:

$$\varphi_i^k = \exp \left\{ \theta \left( \lambda_i + \mu_k + \sum_{\{l,m\}} \beta_{lm} L_{il}^i M_{km}^k \right) \right\} \quad (4)$$

$$\varphi_u^k = \exp \left\{ \theta \left( \lambda_u + \mu_k + \sum_{\{l,m\}} \beta_{lm} L_{il}^u M_{km}^k \right) \right\} \quad (5)$$

From Equation (3), deducing the partial derivation of the relative productivity ( $\varphi_i^k / \varphi_u^k$ ), we have:

$$\frac{\partial (X_{ni}^k / X_{nu}^k)}{\partial (\varphi_i^k / \varphi_u^k)} = \left( \frac{c_i^k}{c_u^k} \right)^{-\theta} \left( \frac{d_{ni}^k}{d_{nu}^k} \right)^{-\theta} > 0 \quad (6)$$

Equation (6) shows that the indicator for exporting country  $i$ 's relative export share of product  $k$  to country  $n$  with respect to a fixed reference of exporting country  $u$ , ( $X_{ni}^k / X_{nu}^k$ ), is positively correlated with the indicator for the relative productivity of the two countries  $i$  and  $u$ , ( $\varphi_i^k / \varphi_u^k$ ).

From Equations (4) and (5), we have:

$$\ln\varphi_i^k - \ln\varphi_u^k = \theta \left[ (\lambda_i - \lambda_u) + (S_i^k - S_u^k) \right] \quad (7)$$

where  $S_i^k = \sum_{\{l,m\}} (\beta_{lm} L_i^l M_m^k)$ , that indicates the synergistic effect of institutional quality and industry heterogeneity. Equation (7) shows that the indicator for the relative productivity of the two countries  $i$  and  $u$ ,  $(\ln\varphi_i^k - \ln\varphi_u^k)$ , is positively correlated with the indicator for the relative synergistic effects of the two countries  $i$  and  $u$ ,  $(S_i^k - S_u^k)$ .

Considering that the expression of  $\varphi_i^k / \varphi_u^k$  and the expression of  $\ln\varphi_i^k - \ln\varphi_u^k$  are positively correlated, it is apparent that the relative export share of the two countries  $i$  and  $u$ ,  $(X_{ni}^k / X_{nu}^k)$ , is positively correlated with the indicator for the relative synergistic effect of the two countries  $i$  and  $u$ ,  $(S_i^k - S_u^k)$ . Most directly, we can reach a conclusion that the synergistic effect of institution quality and industry heterogeneity does promote heterogeneous industries' exports. The mechanism is as follows. On one hand, the formation of the comparative advantage of heterogeneous industries highly depends on the institutional environment, which can be seen as a specific institutional demand of heterogeneous industries. On the other hand, the differentiated institutional environment could release different institutional qualities, which can be seen as a specific institutional supply of the institutional environment. Only when the institutional supply exceeds the institutional demand can the heterogeneous industries achieve an export comparative advantage.

Actually, a country's institutional construction means its dynamic changes in the institutional supply, which exerts different impacts on heterogeneous industries' development. Only in a favorable institutional environment can industries with a high heterogeneity such as a high financial dependence degree, product technology complexity, R&D intensity, or a concentration of immediate inputs acquire good development and achieve export comparative advantages, which means that the synergistic effect of institution quality and industry heterogeneity positively affects the growth of heterogeneous industries' exports. In contrast, in a substandard institutional environment, those industries do not achieve the required institutional supports, and they do not have an export comparative advantage, which means that the synergistic effect of the institution quality and the industry heterogeneity negatively affects the growth of heterogeneous industry exports.

## 2.2. Definition of Institutional Quality and Industry Heterogeneity

### A. Definition of Institutional Quality

The regional institutional environment does affect the development status of heterogeneous industries, which thus influence the formation of the comparative advantage of these industries [16]. In the recent literature studying the impacts of institution on economic development, most of the scholars chose a specific and typical institution as the analytical perspective. This was mainly due to the following two reasons. Firstly, it is much easier to analyze the underlying mechanism of a specific institution affecting the economic variables, since the connotation of an institution is very extensive, and it is almost impossible to set forth the mechanisms of each institution affecting the economic variables [2,14]. Secondly, the measure of institutional quality highly depends on the definition of institution, and the feasibility of the relevant empirical analyses is also directly influenced by the definition of institution and the accurate measure of institutional quality. As a result, more studies choose a specific institution in order to investigate its impacts on economic variables. Referring to the studies such as Levchenko [2], Yang and Maskus [35], and Manova [21], this paper investigates the impacts of institutional quality on heterogeneous industries' exports from the perspectives of the financial system and legal system. Moreover, finance and law are the most important types of institutions in an economic system [32]. In this paper, the quality for the financial system is called the financial development level, and the quality for the legal system is called the legal system efficiency.

### B. Definition of Industry Heterogeneity

The development status of different industries shows adaptive adjustments to the external institutional environment; meanwhile, the institutional environment would exert differentiated impacts on different industries. Referring to Levchenko [2], Chor [34], and Ding et al. [12], this paper investigates industry heterogeneity from the following four dimensions, namely, financial dependence degree, product technology complexity, R&D intensity, and the concentration of immediate inputs. It should be suggested that industries with heterogeneity in degrees of financial dependence or product technology complexity are much more easily influenced by the financial development level, while industries with heterogeneity in R&D intensity or in the concentration of immediate inputs are much more easily influenced by the legal system efficiency. Detailed explanations of the underlying mechanisms are presented in the following contents.

### 2.3. Research Hypotheses

The origin of the thought that institution quality does affect heterogeneous industries' exports could be traced to the Heckscher–Ohlin theory, which indicates that industries making intensive use of a country's abundant factors in the production have an export comparative advantage. If an institution is treated as a specific factor endowment, it is easily concluded that industries with a high dependence on the specific institution would have export comparative advantages in regions with better specific institutional environments. Moreover, institutional environments could affect industries' technology selection, production specialization, or production patterns, and thus influence industries' export comparative advantages [13,36,37].

First of all, we investigate how financial development levels influence heterogeneous industries' exports from the perspectives of industries with different financial dependence degrees or different product technology complexities.

On one hand, in regions with favorable financial development, the credit market and the capital market are highly developed, and the financial market can effectively configure the financial resources among different industries, which helps to decrease the credit constraints of industries and to reduce the cost of external capital for industries. Moreover, in more developed financial markets, the accounting system and auditing system are more complete, and lots of participating agencies make information flow more fluently, which could effectively relieve the information asymmetry between financial agencies and enterprises. Those influence channels would promote the formation of export comparative advantage of industries with high financial dependence [6,38,39]. Manova [21] shows that credit constraints can affect the development of heterogeneous enterprises through the following three ways, namely, production selection, export decision, and the export scale of enterprises, and the development status of enterprises with more dependence on external funding is more easily influenced by regional financial development level. In contrast, the imperfect financial environment could increase the credit constraints of industries and enhance the information asymmetry between financial agencies and enterprises, which thus hinders the formation of the export comparative advantage of industries with high financial dependence [6,32].

On the other hand, industries with high product technical complexity are prone to suffer more external uncertainties and risks [28,40], and institutional environments with low financial development level could drastically obstruct enterprises from adjusting their factor input structures to deal with the external risks. Moreover, those industries usually belong to capital-intensive and technology-intensive industries, which have a long return cycle of investments and a high dependence on a favorable financial environment. These would lead to the enterprises of substandard financial environments being locked into the low end of industry chain and producing products of relatively low technical complexity, thus affecting their export structure. Only in favorable financial environments can industries with high product technical complexity acquire substantial forms of financial support and achieve export comparative advantages.

Based on the analyses above, we propose a hypothesis as follows:

**Hypothesis 1.** *Industries with higher degrees of financial dependence or higher product technical complexities have export comparative advantages in better financial environments.*

Next, we investigate how the legal system efficiency influences heterogeneous industries' exports from the perspectives of industries with different R&D intensities or different concentrations of immediate inputs.

On one hand, regions with perfect legal environments indicate that the judicial system and the intellectual protection system are perfect, which could comprehensively boost industries' R&D activities, effectively protect the industries' R&D fruits, and thus strengthen the export competitiveness of industries with high R&D intensities. Moreover, the favorable legal environment could effectively prevent the abnormal propagation of knowledge and technology among industries, and strengthen the motivation of incumbent enterprises conducting R&D investments. Therefore, industries with higher R&D intensities could achieve export competitions in regions with more perfect legal environments.

On the other hand, industries with a high concentration of intermediate inputs usually obtain most of the intermediate inputs from several suppliers upstream of the industry chain, and the efficiency of contract implementation is extremely important for the production of downstream enterprises. In a sound and legal environment, contractual relationships are more greatly respected, which would lead to a decrease in the incidence of "hold up" problems with suppliers in the production. For industries with a higher concentration of immediate inputs, the enterprises' production is more greatly dependent on specific suppliers, which means that the effective implement of production-related contracts are extremely significant for the production enterprises. According to the incomplete contract theory, only in a relatively complete legal system can the incidence of "hold up" problems with suppliers be dropped considerably [41,42]. Only in a more favorable legal environment can industries with high concentrations of immediate inputs achieve better development. Levchenko [2] shows that if enterprises' production does not depend on the spot markets, they usually require the establishment of complex contractual relationships in the factor markets, and regular production and the production cost control are largely dependent on the quality of the external legal system. Nunn [19] suggests that the fact that an incomplete contract leads to efficiency loss from under-investment in relationship-specific investments would increase the cost of intermediate inputs, and compared with regions with low efficiency of contract enforcement, regions with high efficiency of contract enforcement have comparative advantage in products with relationship-specific investments. Acemoglu et al. [36] conclude that industries with high complementary of intermediate inputs are more sensitive to contract system, and they are easier to form comparative advantage in regions with favorable contract implementation environments. Therefore, the improvement of legal system could reduce the risk of "hold up" problems with suppliers, and thus strengthen the export competitiveness of industries with high concentrations of intermediate inputs.

Based on the analyses above, we propose a hypothesis as follows:

**Hypothesis 2.** *Industries with higher R&D intensities or higher concentrations of intermediate inputs have export comparative advantages in better legal environments.*

As suggested in the analyses above, institutional quality measuring the perfection degree of the institution has significant impacts on heterogeneous industries' exports, and these impacts depend on the interaction between institutional quality and industries' characteristics in affecting industries' exports. Theoretically, the differences in the level of financial development or in the efficiency of the legal system would exert differentiated impacts on the above-mentioned interactions.

The characteristics of industry heterogeneity are usually relatively stable over the years, while the quality of institution shows continuous changes among years, especially for emerging countries such as China. In China, the quality of institutions has shown a rising trend in the last 20 years, according to the data from World Bank's Worldwide Governance Indicators (WGI). The improving institutional environment releases different degrees of institutional strength, which might exert

nonlinear impacts on the interaction between institutional quality and industries' characteristics in affecting industries' exports. As for industries with specific heterogeneity, the inefficient institutional environment would block this industry's development, which shows that the interaction between institutional quality and industry's heterogeneity has a negative effect on the industry's exports; with the continuous improvement of the institutional environment [43], the rising institutional quality would release enough institutional strength for the development of the industry, which shows that the interaction between institutional quality and industries' characteristics has a positive effect on the industry's exports.

Considering the definition of institutional quality from the perspectives of financial development level and legal system efficiency, based on the analyses above, we propose a hypothesis as follows:

**Hypothesis 3.** *The differences in the level of financial development or in the efficiency of the legal system would influence the effects of the interaction between institutional quality and industry heterogeneity on the sustainable development of industry exports.*

### 3. Econometric Specification and Data Selection

#### 3.1. Econometric Specification

The key foundations of econometric specification in this paper are as follows. First, the empirical estimation is based on an extended gravity model, which is widely used to investigate the factors that affect bilateral trade volumes [44–46]. It is a consensus that, in a gravity model, the industry-level exports could be seen as a function of the GDP, geographical distance, industry features, the tariff barrier, the non-tariff barrier, and the dummy variables as defined below. A large volume of literature, such as Karam and Zaki [31], and Guglielmo et al. [45], applies this model to investigate the factors affecting bilateral trade. Second, in order to examine the above-mentioned hypotheses, this paper establishes an empirical estimation incorporating the interaction between institutional quality and industry heterogeneity by referring to Nunn [19] and Chor [34], which is a basic approach to identify the relation above in existing literature. Rajan and Zingales [39] apply this method to inspect whether industries with a high dependence of external finances develop relatively faster in regions with more developed financial markets, by using data on a large sample of countries in the 1980s. Levchenko [2] employs this method to investigate whether the quality of contract enforcement acts as a source of trade by using data from American imports disaggregated by country and industry. Nunn [19] and Chor [34] use this method to examine the role of the institution in shaping trade patterns. Unlike the studies above, conducting an empirical analysis on cross-country samples or developed countries, such as Nunn [19] and Chor [34], this paper uses the same method to inspect the role of multi-dimensional institutions in promoting the sustainable development of industries' exports for emerging countries. Therefore, the method above is feasible in this study. Moreover, considering a fact that there are substantial trade barriers in trading in emerging countries, the econometric specification of this study completely controls the possible impacts of tariff barriers and non-tariff barriers, to accurately identify the role of the institution in promoting the sustainable development of industries' exports. In this paper, the econometric model is set as follows:

$$\begin{aligned} \ln Exp_{it} = & \beta_0 + \beta_1 \ln GDP_{i,t}^C + \beta_2 \ln GDP_{i,t}^P + \beta_3 \ln Dist_t + \beta_4 Border_t + \beta_5 Inst_t \\ & + \beta_6 Inst_t \cdot Hete_i + \beta_7 CL_{it} + \beta_8 Trarif_{it} + \beta_9 AD_{it} + \varphi_i + \delta_t + \mu_{it} \end{aligned} \quad (8)$$

where  $i$  and  $t$  are the industry and year, respectively;  $\ln Exp$  is the natural logarithm of industry-level export value;  $\ln GDP^C$  and  $\ln GDP^P$  are the logarithm of China and China's trading partner country, respectively;  $\ln Dist$  is the log-weighted distance of two trading countries, which is measured by the geographical distance multiplied by petroleum price index;  $Border$  is a dummy variable that indicates whether the two trading countries are neighboring;  $Inst$  and  $Hete$  are the institutional quality and

industry heterogeneity, respectively;  $CL$  and  $Trariff$  are the structure of the industries' factor inputs and the average tariff, respectively;  $AD$  is the average anti-dumping degree of industries suffering from other countries;  $\varphi_i$  and  $\delta_t$  are the industry effect and the time effect, respectively;  $\mu_{it}$  is the residual item;  $\beta_0$  is the constant item and  $\beta_1, \beta_2, \dots, \beta_9$  are the coefficients. We focus on the coefficient of  $\beta_6$  that indicates the interaction effect of institutional quality and industry heterogeneity on industry exports; a positive  $\beta_6$  suggests that the interaction between institutional quality and industry heterogeneity helps to promote heterogeneous industries' exports, while a negative  $\beta_6$  illustrates that the interaction hinders heterogeneous industries' exports.

### 3.2. Variables and Data

#### A. Variables for Institutional Quality

As is suggested in Sections 1 and 2, two types of institutions, namely, financial development level and legal system efficiency, are selected to investigate the interaction effect of institutional quality and industry heterogeneity on heterogeneous industries' exports in this study. The first-order lagged variable for institutional quality is added into Equation (8) to alleviate the potential endogenous problem in the regression estimation.

##### (1) Financial Development Level (*FDL*)

Financial development level is used to measure the perfection degree of the financial environment, and the efficiency of financial resource allocation in the financial system. The indicators measuring regional financial development level are abundant, such as the proportion of non-state-owned enterprises loans in the total loans and the ratio of total bank loans to GDP. In this paper, we use the ratio of financial system's deposits and loans to GDP to measure the financial development level. In the robustness checks, we also use the ratio of the financial system's loans to the GDP as an alternative indicator for the financial development level. The data are from *China Financial Yearbook* and *China Statistical Yearbook*.

##### (2) Legal System Efficiency (*LSE*)

Legal system efficiency is used to measure the perfection degree of the legal system, and the efficiency of the legal contract enforcement. The indicators measuring the legal system efficiency are also abundant, among which the representative indicators include the World Bank's *Worldwide Governance Indicators* (WGI) and Ginarte and Park's [47] Indicators (GPI). Ginarte and Park [47] measure the property protection intensity from the following five aspects: *the coverage of protection, membership in international agreements, loss of protection, enforcement, and duration of protection*. After considering the difference in institution implementation among countries, Han and Li [48] conducted a widely-used correction method by Ginarte and Park [47], and we selected the improved-GPI to measure the legal system efficiency in China, since the indicator of property protection intensity could be seen as a significant dimension of legal system efficiency. The data are from the *China Legislative Information Yearbook*, *China Statistical Yearbook* and *WTO database*. In the robustness checks, we took one sub-index of World Bank's *Worldwide Governance Indicators*, *Rule of Law*, to measure legal system efficiency.

#### B. Dimensions for Industry Heterogeneity

In this paper, industry heterogeneity is investigated from the following four dimensions: financial dependence degree, product technology complexity, R&D intensity, and the concentration of intermediate inputs.

##### (1) Financial Dependence Degree (*fdd*)

The most representative and widely-used indicator measuring financial dependence is raised by Rajan and Zingales [39], who measure financial dependence degree by the dependence degree of industries' or enterprises' external financing. Following recent studies such as Chor [34] and

Manova [21], we also used this indicator to measure the industries' financial dependence in this paper. The data are from *China Industry Statistics Yearbook*.

(2) Product Technology Complexity (*ptc*)

Based on the labor division theory, Costinot [20] decomposes the production process into several basic units (a set of elementary tasks) according to the product complexity. When the production technology is more complex, it would take a longer training time in the process, which would then lead to a higher income of specialized divided labor. This provides us with a new idea by which to measure product technology complexity; most directly, the average training time could be used to measure product technology complexity for industries. Costinot [20] calculates the average training time for 3-digit Standard Industrial Classification (SIC) industries based on the survey data. We directly use the data to measure the product technical complexity for industries in this study.

(3) R&D Intensity (*rdi*)

In this paper, we measured R&D intensity by the ratio of R&D expenditure to the output value for industries, and this indicator is widely used in the literature. The data are from *China Industrial Statistical Yearbook*.

(4) Concentration of Intermediate Inputs (*cii*)

As Levchenko [1] indicates, the concentration of intermediate inputs is a better indicator than the number of intermediate input factors to measure the external production linkages for industries, since the latter indicator would overestimate the linkages. Kevin and Neut [49], and Levchenko [2] use the Herfindahl Index of intermediate inputs to measure this indicator. On one hand, the Herfindahl Index positively correlates with the concentration degree of immediate inputs. The higher concentration of intermediate inputs shows the greater demand of several specific factors in the production process, which requires a good contractual relationship between enterprises and their suppliers, and thus they highly depend on more perfect institutional environments. On the other hand, the indicator of the number of intermediate input factors would overestimate the dependence of the enterprises' production relations on the institutional quality, because the difference in the amounts among the intermediate input factors is ignored. The indicator of concentration of intermediate inputs is calculated as follows:

$$cii_i = \sum_{j=1}^J \left( \frac{X_{ij}}{X_i} \right)^2 \quad (9)$$

where  $i$  and  $j$  indicate the industry;  $J$  is the number of intermediate factors;  $cii_i$  is the concentration of intermediate inputs for industry  $i$ ;  $X_i$  is the total amounts of intermediate inputs for industry  $i$ ;  $X_{ij}$  is the amounts of intermediate inputs from industry  $j$  to industry  $i$ . In the calculation process, we use *Chinese Input-Output Table* for the years of 1997, 2000, 2002, 2005, 2007, and 2010. Since the input-output table is not continuous, we have adopted the following replacement method: using the 1997 input-output table to gather the data of 1996, 1997, and 1998, using the 2000 input-output table to gather the data of 1999, 2000, and 2001, using the 2002 input-output table to gather the data of 2002 and 2003, using the 2005 input-output table to gather the data of 2004, 2005, and 2006, using the 2007 input-output table to gather the data of 2007 and 2008, and using the 2010 input-output table to gather the data of 2009, 2010, and 2011.

### C. Other Variables

The illustration for the other variables in Equation (8) and the data source are presented as follows:

(1) Variable for Export (*Exp*)

The data of export are from the *UN Comtrade database*, which has been added to the 2-digit industry by referring to the Product Classification Criterion of Ju et al. [50].

(2) Variables for GDP, Distance, and Border ( $GDP^C$ ,  $GDP^P$ ,  $Dist$ ,  $Border$ )

The data of real GDP for countries ( $GDP^C$ ,  $GDP^P$ ) are from the World Bank's *Worldwide Development Index database*. The weighted distance of two trading countries ( $Dist$ ), is measured by the geographical distance, multiplied by the petroleum price index. The data for the geographical distance between countries and whether the two countries are neighboring ( $Border$ ) are from the *BACK-CEPII database*. The data for the petroleum price index are from the *International Monetary Fund database*.

(3) Variable for the Structure of Industry-level Factor Inputs ( $CL$ )

The structure of factor inputs ( $CL$ ) could be used to investigate the changes of production technology, and thus influence the relative changes of comparative advantage for industries. The indicator for  $CL$  is calculated as follows:

$$CL_{it} = Cap_{it}/Lab_{it} \quad (10)$$

where  $i$  and  $t$  are the industry and year, respectively;  $CL$  is the structure of the factor inputs,  $Cap$  and  $Lab$  are the capital stock and the labor amount in the production. The capital stock is calculated by the perpetual inventory method as follows:

$$Cap_t = (1 - r)Cap_{t-1} + I_t \quad (11)$$

$$Cap_0 = I_0 / (r + g) \quad (12)$$

where  $t$  is the year;  $r$  is the depreciation rate (10% in this paper);  $Cap_0$  and  $I_0$  are the initial investment and the initial capital stock, respectively;  $g$  is the growth rate of investment in the sample period.

(4) Variables for Tariff and Anti-Dumping ( $Tariff$ ,  $AD$ )

Considering that factors such as tariff and non-tariff barriers are the most important obstacles that hinder the enhancement of exports, the following proxy variables for tariff and non-tariff barriers are added into the empirical equation [51,52].

First, the average tariff rate for China's industries is calculated as follows:

$$Tar_{Ht} = \sum_C (\omega_{Ht}^C \cdot tar_{Ht}^C), \quad (13)$$

$$Tariff_{jt} = \frac{1}{n} \sum_H Tar_{Ht} \quad (14)$$

where  $t$  is the year;  $H$  is HS2-industry;  $C$  is the selected China's trading partners;  $Tar$  is the average tariff rate for China's HS2-industries' exports;  $\omega$  and  $tar$  is the weight and the actual tariff rate for China's HS2-industries' exports to the selected trading partners, respectively;  $Tariff$  is the average tariff rate for the 2-digit industry of Ju et al. [50];  $n$  is the number of HS2 industries for each 2-digit industry of Ju et al. [50] by referring to the Product Classification Criterion of Ju et al. [50]. Considering that the three greatest trading partners of China are the United States (US), the European Union (EU), and Japan, we select these three countries to estimate the average tariff rate of China's industries' exports in this paper. The data of the actual tariff rate are from the *WTO database*, and the data of HS2-industry exports are from the *UN Comtrade database*.

Second, the actual anti-dumping cases of industries' exports suffering from the other countries could be a typical indicator to investigate the impact of non-tariff barriers on industries' exports. Therefore, we use the number of anti-dumping cases to measure the degree of non-tariff barriers for China's industries' exports. The data are from the *Temporary Trade Barriers Database (TTBD)*.

### 3.3. The Evolution of China's Institutional Environment

For emerging countries such as China, domestic institutional quality shows a great difference over the years, due to the policy of Reform and Opening-Up, and the transition undergoing in the aspects of economy and society. Using the indicators of institutional quality above, Figure 1 shows the trends of China's institutional quality in the period of 1995–2011. Both the financial development level (*FDL*) and the legal system efficiency (*LSE*) grew steadily during the period. Combined with the fact that China is the largest export economy in the world, it provides us with a perspective to investigate the relations between the institutional environment and the sustainable development of industries' exports in a single emerging country.

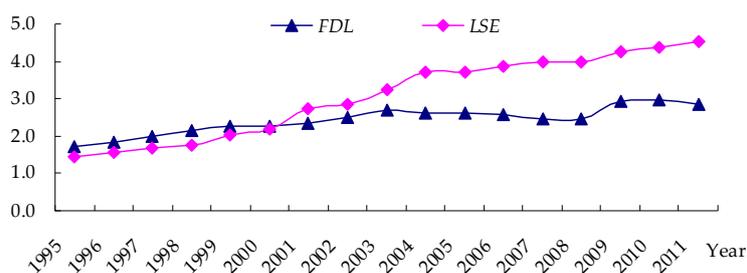


Figure 1. Development trends of China's institutional environment.

## 4. Empirical Analyses

In the empirical analyses, we will use the data from China's 20 industries' exports to 117 countries for the period of 1996–2011 to examine the theoretical hypotheses proposed in Section 2.

### 4.1. Baseline Regression Analyses

We firstly examine the effects of institutional quality on industries' exports, and the underlying mechanisms of the above-mentioned effects. The regression results are shown in Table 1.

Firstly, in Columns 1–3 of Table 1, the coefficients for the financial development level (*FDL*) and the coefficients for the interactions ( $FDL*fdi$ ,  $FDL*ptc$ ) are significantly positive, which confirms Hypothesis 1, in that industries with higher financial dependence degrees or higher product technical complexities have export comparative advantages in better financial environments. Most directly, financial development helps to promote industries' exports, and the underlying mechanisms include the following two channels, namely, to relieve industries' financing constraints and to enhance industries' product technical complexity. On one hand, in an institutional environment with a low financial development level, financial resources are relatively scarce, and thus, the interest rate is relatively high in an economic system; moreover, the phenomenon of information asymmetry between financial agencies and enterprises are relatively apparent. As a result, the external financing constraints could raise the financial cost and weaken the international competitiveness for industries, especially for industries with high financial dependence degrees. On the other hand, industries with high technology complexities are prone to suffer more external uncertainties and risks [16,40], and institutional environments with low financial development levels could drastically obstruct the enterprises from adjusting their factor input structures to deal with the external risks. This would lead to enterprises of substandard financial environments being locked in the low end of the industry chain, and producing relatively low technical complexity products, thus affecting their export structure.

Secondly, in Columns 4–6 of Table 1, the coefficients for legal system efficiency (*LSE*) and the coefficients for the interactions ( $LSE*rd$ ,  $LSE*cii$ ) are significantly positive, which confirms Hypothesis 2, in that industries with higher R&D intensities or higher concentrations of intermediate inputs have export comparative advantages in better legal environments. The underlying mechanisms are as follows. On one hand, the perfect legal system could comprehensively boost industries' R&D activities and effectively protect industries' R&D fruits, which could strengthen the export

competitiveness of industries with high R&D intensities. On the other hand, industries with high concentrations of intermediate inputs of industries usually obtain the most of immediate inputs from several suppliers in the upstream of the industry chain, and the efficiency of contract implementation is extremely important in the production process. According to the incomplete contract theory, only in a relatively complete legal system can the incidence of “hold up” problems with suppliers be dropped considerably [41,42]. As a result, the improvement of the legal system could reduce the risk of “hold up” problems with suppliers, and thus strengthen the export competitiveness of industries with high concentration of intermediate inputs.

**Table 1.** Baseline regression results.

	Financial Development Level (FDL)			Legal System Efficiency (LSE)		
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>FDL</i>	<i>FDL*fd</i>	<i>FDL*ptc</i>	<i>LSE</i>	<i>LSE *rdi</i>	<i>LSE *cii</i>
<i>GDP<sup>C</sup></i>	2.799 *** (0.118)	2.824 *** (0.118)	2.734 *** (0.118)	1.627 *** (0.096)	1.315 *** (0.144)	1.592 *** (0.095)
<i>GDP<sup>P</sup></i>	0.941 *** (0.020)	0.941 *** (0.020)	0.940 *** (0.020)	0.940 *** (0.021)	0.940 *** (0.021)	0.940 *** (0.021)
<i>Dist</i>	−0.613 *** (0.057)	−0.613 *** (0.057)	−0.614 *** (0.057)	−0.614 *** (0.057)	−0.614 *** (0.057)	−0.614 *** (0.057)
<i>Border</i>	0.616 *** (0.115)	0.617 *** (0.115)	0.615 *** (0.115)	0.616 *** (0.115)	0.616 *** (0.115)	0.616 *** (0.115)
<i>Inst</i>	0.501 *** (0.016)	0.462 *** (0.019)	0.391 *** (0.037)	0.933 *** (0.020)	0.581 *** (0.113)	0.889 *** (0.032)
<i>Inst*Hete</i>		0.093 *** (0.025)	0.046 *** (0.013)		0.021 *** (0.007)	0.174 * (0.096)
<i>CL</i>	0.009 *** (0.001)	0.009 *** (0.001)	0.008 *** (0.001)	0.002 ** (0.001)	0.002 ** (0.001)	0.002 ** (0.001)
<i>Tariff</i>	−0.034 (0.056)	−0.010 (0.057)	0.010 (0.059)	−0.069 (0.056)	−0.150 ** (0.064)	−0.108 * (0.060)
<i>AD</i>	−0.007 ** (0.003)	−0.006 ** (0.003)	−0.005 * (0.003)	−0.008 *** (0.003)	−0.010 *** (0.003)	−0.008 *** (0.003)
<i>C</i>	−58.961 *** (2.434)	−59.521 *** (2.426)	−57.780 *** (2.431)	−36.628 *** (2.033)	−30.109 *** (3.081)	−35.746 *** (2.049)
<i>Industry and Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	37.440	37.440	37740	3.7440	37440	37740
<i>Within-R2</i>	0.540	0.541	0.540	0.592	0.592	0.592

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

Finally, some other conclusions can be drawn from Table 1. First, from Table 1, it is evident that trading countries with larger economic sizes, closer distances, and neighboring relations with trading partners could lead to more trade volumes, which is in line with the traditional gravity effects [44–46]. Second, the enhancement of capital density would significantly promote industries’ exports. The high ratio of capital inputs to labor inputs is largely due to technology upgrading and input structure optimization in the production process, which would gradually improve the international competitiveness of industries’ products. Third, the negative effect of tariff barriers on China’s industries’ exports is not completely revealed, while anti-dumping has been a significant impediment to China’s industries’ exports. With more and more free trade agreements being signed by China and other trading countries, especially China’s accession to the WTO, the practical tariff rate of China’s industries exports is decreasing considerably; meanwhile, non-tariff barriers such as anti-dumping have been one of the main trade barriers to China’s industries exports.

#### 4.2. Regression Analyses for Sub-Samples of Industries with Different Degrees of Heterogeneity

As is suggested in Section 3, this paper defines industry heterogeneity from the following four aspects, namely, (a) financial dependence degree (*fd*), (b) product technology complexity (*ptc*), (c) R&D intensity (*rdi*) and (d) concentration of intermediate inputs (*cii*). In order to further examine Hypothesis

1 and Hypothesis 2, the investigated 20 industries for each dimension of industry heterogeneity are divided into four sub-samples based on the average rank of industry heterogeneity in the observation period, namely, low-level heterogeneity, medium-low-level heterogeneity, medium-high-level heterogeneity, and high-level heterogeneity. Tables 2 and 3 present the regression results of financial development level on heterogeneous industries' exports and the regression results of legal system efficiency on heterogeneous industries' exports, respectively.

**Table 2.** Regression results of financial development affecting heterogeneous industries' exports.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>GDP<sup>C</sup></i>	3.402 *** (0.308)	2.983 *** (0.209)	3.196 *** (0.237)	3.421 *** (0.165)	0.729 *** (0.208)	4.154 *** (0.275)	4.134 *** (0.150)	2.421 *** (0.238)
<i>GDP<sup>P</sup></i>	0.938 *** (0.047)	0.910 *** (0.043)	0.959 *** (0.036)	0.983 *** (0.032)	0.887 *** (0.023)	0.984 *** (0.039)	1.028 *** (0.031)	0.866 *** (0.028)
<i>Dist</i>	−0.762 *** (0.128)	−0.684 *** (0.123)	−0.715 *** (0.097)	−0.277 *** (0.094)	−0.486 *** (0.117)	−0.885 *** (0.112)	−0.567 *** (0.089)	−0.514 *** (0.137)
<i>Border</i>	0.856 *** (0.257)	0.808 *** (0.238)	0.258 (0.208)	0.577 *** (0.200)	0.824 *** (0.219)	0.692 *** (0.231)	0.313 (0.192)	0.641 ** (0.257)
<i>FDL</i>	0.230 *** (0.035)	−0.514 ** (0.220)	0.658 *** (0.075)	0.589 *** (0.051)	0.253 *** (0.039)	0.661 ** (0.289)	−0.115 (0.431)	0.698 *** (0.266)
<i>FDL*<i>fdd</i></i>	2.362 *** (0.594)	4.060 *** (1.100)	−0.126 (0.207)	−0.187 *** (0.048)				
<i>FDL*<i>ptc</i></i>					0.270 *** (0.017)	−0.172 (0.111)	0.207 (0.142)	−0.071 (0.077)
<i>CL</i>	0.016 *** (0.001)	0.012 *** (0.001)	0.010 *** (0.001)	0.019 *** (0.001)	0.004 *** (0.001)	0.018 *** (0.001)	0.013 *** (0.001)	0.008 *** (0.001)
<i>Tariff</i>	−4.240 *** (0.376)	−8.068 *** (0.597)	−14.129 *** (1.015)	−42.532 *** (2.020)	−3.961 *** (0.893)	−0.035 *** (0.012)	−49.409 *** (1.758)	−18.018 *** (1.719)
<i>AD</i>	−0.033 *** (0.011)	−0.015 *** (0.004)	−0.068 *** (0.012)	−0.019 ** (0.009)	−0.006 (0.006)	−0.107 *** (0.012)	−0.054 *** (0.004)	−0.005 (0.006)
<i>Industry and Year</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	9360	9360	9360	9360	9360	9360	9360	9360
<i>Within-R2</i>	0.488	0.517	0.600	0.628	0.526	0.579	0.668	0.452

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

Though the coefficients of interactions (*FIN\*fdd*, *FIN\*ptc*) are significantly discrepant among the columns of Table 2, they are not contradictory with Hypothesis 1, and new findings emerge here in Table 2. The interactions can also be used to investigate the diversified impacts of institutional quality on exports of industries with different degrees of heterogeneity, and the coefficients for interactions can be called the synergistic effects of institutional quality and industry heterogeneity on heterogeneous industries' exports [34]. Columns 1–4 of Table 2 shows that at the present stage, financial development level could only satisfy the internal requirement of industries with low-level and middle–low-level financial dependence and promote these industries' exports, while industries with middle–high-level and high-level financial dependence could not obtain adequate financial supports from the present financial system of China, and thus result in the exports' slowdown. Moreover, from Columns 5–8 of Table 2, it is concluded that at present, the synergistic effects of institutional quality and industry heterogeneity could only promote the exports of industries with low-level product technology complexity in China. The reason is probably due to the much greater requirement of industries with higher product technology complexity in China.

Following the analyses above, the discrepant coefficients of interaction (*LAW\*rdi*, *LAW\*cii*) in Table 3 are not contradictory with Hypothesis 2, and new findings emerge here. From Table 3, it is concluded that at the present stage of China, the legal system efficiency has been hindering the exports of industries with middle–high-level and high-level R&D intensities, or high-level concentration of intermediate inputs. The reason is probably that the formation of these industries' comparative advantage requires adequate institutional supports from a complete legal system, which is still a long way for today's China to achieve this aim. In Column 1 and Column 5, the impact of institutional quality on industries with low R&D intensities or low concentrations of immediate inputs is not remarkable, the possible reason for which is that these industries have an extremely low dependence

on the legal environment, and that the changing legal system of China hardly promotes the exports of these industries. The results of Table 3 are also in line with Francois and Manchin [43], which indicates that the low institutional quality of the southern countries limits their trade with the northern countries.

**Table 3.** Regression results of the legal system affecting heterogeneous industries' exports.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Low-Level	Middle-Low-Level	Middle-high-level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>GDP<sup>C</sup></i>	1.372 *** (0.281)	1.628 *** (0.319)	2.594 *** (0.407)	0.963 *** (0.354)	2.283 *** (0.235)	1.849 *** (0.172)	1.457 *** (0.169)	1.398 *** (0.212)
<i>GDP<sup>P</sup></i>	1.066 *** (0.042)	0.959 *** (0.039)	0.870 *** (0.044)	0.888 *** (0.036)	1.028 *** (0.041)	1.003 *** (0.037)	0.820 *** (0.039)	0.924 *** (0.043)
<i>Dist</i>	−0.564 *** (0.115)	−0.396 *** (0.106)	−0.725 *** (0.133)	−0.757 *** (0.094)	−0.528 *** (0.118)	−0.363 *** (0.092)	−0.703 *** (0.108)	−0.851 *** (0.127)
<i>Border</i>	0.612 ** (0.258)	0.877 *** (0.220)	0.652 ** (0.254)	0.350 * (0.189)	0.564 ** (0.234)	0.415 * (0.217)	0.762 *** (0.208)	0.742 *** (0.245)
<i>LSE</i>	0.829 *** (0.130)	1.165 *** (0.262)	1.773 *** (0.361)	1.262 *** (0.432)	0.647 *** (0.051)	0.552 *** (0.098)	0.498 *** (0.083)	1.127 *** (0.078)
<i>LSE *rdi</i>	0.009 (0.008)	0.038 ** (0.016)	−0.057 *** (0.021)	−0.062 *** (0.022)				
<i>LSE *cii</i>					0.319 (0.287)	2.031 *** (0.351)	1.219 *** (0.210)	−0.454 *** (0.172)
<i>CL</i>	0.001 (0.001)	0.012 *** (0.001)	0.001 (0.001)	0.012 *** (0.002)	0.004 ** (0.002)	0.006 *** (0.001)	0.004 *** (0.001)	0.004 *** (0.001)
<i>Tariff</i>	−4.406 *** (0.797)	0.102 (0.067)	−3.245 *** (0.493)	−4.532 *** (1.512)	−28.999 *** (2.849)	−7.891 *** (0.633)	−6.454 *** (0.743)	−1.837 *** (0.272)
<i>AD</i>	−0.050 *** (0.007)	−0.045 *** (0.008)	−0.001 (0.005)	−0.021 *** (0.004)	−0.029 *** (0.011)	−0.013 * (0.007)	−0.025 *** (0.005)	−0.003 (0.004)
<i>Industry and Year</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	9360	9360	9360	9360	9360	9360	9360	9360
<i>Within-R2</i>	0.575	0.670	0.485	0.678	0.536	0.704	0.612	0.548

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

#### 4.3. Regression Analyses for Sub-Samples of Different Institutional Quality

In the observed period of 1996–2011, the quality of China's institution (measured by financial development level and legal system efficiency) has shown a rising trend over years. To examine Hypothesis 3, the observed period of 1996–2011 is divided into the period for 1996–2003, and the period for 2004–2011, and thus, two sub-samples are obtained from the overall sample to investigate the impacts of the differences in the level of financial development, or in the efficiency of legal systems on heterogeneous industries' exports. Tables 4 and 5 present the regression results for the impact of different financial development degrees on heterogeneous industries' exports and the regression results for the impact of different legal system efficiency on heterogeneous industries' exports, respectively.

From Table 4, it is concluded that financial development does help to promote industries' exports, and only in an institutional environment with higher financial development level can industries with higher financial dependence degrees or industries with higher product technology complexities achieve export comparative advantages. These results were in line with Hypothesis 3, in that the difference in the level of financial development would influence the effects of interaction between institutional quality and industry heterogeneity on the sustainable development of industries' exports. The results of Table 4 also suggest that there is a nonlinear mechanism in the impact of financial development on heterogeneous industries' exports. Only when the level of financial development crosses a certain threshold that meets heterogeneous industries' requirements on the financial system, can the improvement of the financial system promote heterogeneous industries' exports. These results are also in accordance with Chor [34] who studies the synergistic effects of country-level institutions and industry-level features on the formation of comparative advantages.

**Table 4.** Regression results for different financial development degrees.

	(1)	(2)	(3)	(4)	(5)	(6)
	Low	High	Low	High	Low	High
<i>GDP<sup>C</sup></i>	3.326 *** (0.696)	3.668 *** (0.088)	3.398 *** (0.691)	3.666 *** (0.088)	3.393 *** (0.707)	3.672 *** (0.088)
<i>GDP<sup>P</sup></i>	0.960 *** (0.016)	0.827 *** (0.017)	0.960 *** (0.016)	0.827 *** (0.017)	0.960 *** (0.016)	0.827 *** (0.017)
<i>Dist</i>	−0.754 *** (0.064)	−0.531 *** (0.053)	−0.754 *** (0.064)	−0.531 *** (0.053)	−0.754 *** (0.064)	−0.531 *** (0.053)
<i>Border</i>	0.516 *** (0.136)	0.614 *** (0.108)	0.517 *** (0.136)	0.614 *** (0.108)	0.517 *** (0.136)	0.614 *** (0.108)
<i>FDL</i>	0.961 *** (0.040)	0.027 *** (0.010)	0.934 *** (0.046)	−0.004 (0.013)	1.015 *** (0.083)	0.103 *** (0.031)
<i>FDL*fd</i>			0.057 (0.057)	0.082 *** (0.021)		
<i>FDL*ptc</i>					−0.023 (0.031)	0.050 *** (0.011)
<i>CL</i>	0.005 *** (0.001)	0.002 (0.002)	0.005 *** (0.001)	0.002 (0.002)	0.005 *** (0.001)	0.000 (0.002)
<i>Tariff</i>	−0.038 (0.066)	−0.097 * (0.054)	−0.028 (0.067)	−0.070 (0.054)	−0.053 (0.070)	−0.034 (0.056)
<i>Dumping</i>	−0.030 *** (0.004)	−0.015 *** (0.002)	−0.030 *** (0.004)	−0.015 *** (0.002)	−0.029 *** (0.005)	−0.013 *** (0.002)
<i>C</i>	−69.354 *** (13.907)	−73.269 *** (1.847)	−70.824 *** (13.797)	−73.299 *** (1.847)	−70.641 *** (14.116)	−73.519 *** (1.847)
<i>Industry and Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	18.720	18.720	18.720	18.720	18.720	18.720
<i>Within-R2</i>	0.290	0.338	0.290	0.340	0.290	0.340

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

**Table 5.** Regression results for different legal system efficiency.

	(1)	(2)	(3)	(4)	(5)	(6)
	Low	High	Low	High	Low	High
<i>GDP<sup>C</sup></i>	0.801 (0.922)	2.686 *** (0.110)	0.518 (0.934)	2.597 *** (0.117)	0.510 (0.928)	2.679 *** (0.111)
<i>GDP<sup>P</sup></i>	0.954 *** (0.017)	0.836 *** (0.017)	0.954 *** (0.017)	0.836 *** (0.017)	0.954 *** (0.017)	0.836 *** (0.017)
<i>Dist</i>	−0.758 *** (0.065)	−0.525 *** (0.053)	−0.758 *** (0.064)	−0.525 *** (0.053)	−0.758 *** (0.064)	−0.525 *** (0.053)
<i>Border</i>	0.509 *** (0.136)	0.624 *** (0.108)	0.508 *** (0.136)	0.624 *** (0.108)	0.509 *** (0.136)	0.624 *** (0.108)
<i>LSE</i>	0.973 *** (0.049)	0.530 *** (0.047)	0.635 *** (0.104)	0.003 (0.235)	0.922 *** (0.053)	0.520 *** (0.063)
<i>LSE *rdi</i>			0.010 * (0.006)	0.024 ** (0.010)		
<i>LSE *cii</i>					0.136 * (0.076)	0.239 *** (0.067)
<i>CL</i>	0.004 *** (0.001)	0.001 (0.002)	0.004 *** (0.001)	0.001 (0.002)	0.004 *** (0.001)	0.001 (0.002)
<i>Tariff</i>	−0.041 (0.066)	−0.098 * (0.053)	−0.100 (0.070)	−0.215 *** (0.073)	−0.079 (0.068)	−0.109 (0.069)
<i>AD</i>	−0.022 *** (0.004)	−0.014 *** (0.002)	−0.024 *** (0.004)	−0.014 *** (0.002)	−0.022 *** (0.004)	−0.014 *** (0.002)
<i>C</i>	−18.999 (18.361)	−55.630 *** (2.126)	−13.143 (18.603)	−53.069 *** (2.413)	−13.077 (18.487)	−55.448 *** (2.193)
<i>Industry and Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	18720	18720	18720	18720	18720	18720
<i>Within-R2</i>	0.281	0.342	0.282	0.342	0.281	0.342

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

From Table 5, it is concluded that the legal system construction does help to promote industries' exports, while different legal system efficiencies exert differentiated degrees of influence on heterogeneous industries' exports. These results are in line with Hypothesis 3, in that the difference in the efficiency of legal system would influence the effects of interaction between institutional quality and industry heterogeneity on the sustainable development of industries' exports. The rising legal system efficiency can promote heterogeneous industries' exports by encouraging industries' R&D investments and ensuring the stable input of intermediate factors. However, in an institutional environment with a higher legal system efficiency, industries with a higher R&D intensity or a higher concentration of immediate inputs could achieve a greater comparative advantage.

## 5. Robustness Checks

To illustrate the robustness of the aforementioned analysis results, two other approaches are used to conduct regression testing in this paper, namely, using the alternative proxies of institutional quality and adopting the instrumental variable method.

First, the alternative proxies for institutional quality are used to conduct regression analyses again. The indicator for financial development level is measured by the ratio of bank loans amounts to GDP, and the indicator for legal system efficiency is measured by the scores of *Rule of Law* from one dimension of World Bank's *Worldwide Governance Indicators* (WGI). The main results are presented in Table 6. Overall, the results from Table 6 are almost in line with the regression results of Section 4, which confirms the robustness of the above-mentioned conclusions.

**Table 6.** Regression results for the alternative proxies of institutional quality.

Regression results of financial development affecting heterogeneous industries' exports								
	FDL* <i>fdd</i>				FDL* <i>ptc</i>			
	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>Inst</i>	0.607 *** (0.231)	3.990 *** (0.968)	3.067 *** (0.644)	2.988 *** (0.446)	−0.222 (0.542)	6.256 ** (2.719)	6.331 *** (2.095)	1.147 (4.546)
<i>Inst*Hete</i>	4.319 (5.402)	3.436 *** (1.120)	−2.039 (1.872)	−1.538 *** (0.460)	1.910 *** (0.311)	−2.197 ** (1.026)	−3.096 ** (1.360)	−3.175 ** (1.353)
<i>Within-R2</i>	0.481	0.515	0.592	0.619	0.504	0.577	0.664	0.447
Regression results of the legal system affecting heterogeneous industries' exports								
	LSE* <i>rdi</i>				LSE* <i>cii</i>			
	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>Inst</i>	−0.166 *** (0.010)	−0.369 *** (0.020)	−0.232 *** (0.042)	−0.550 *** (0.024)	0.008 (0.007)	−0.115 *** (0.007)	−0.049 *** (0.006)	−0.005 (0.005)
<i>Inst*Hete</i>	0.010 *** (0.001)	0.020 *** (0.001)	0.012 *** (0.002)	−0.027 *** (0.001)	0.098 *** (0.031)	0.302 *** (0.025)	0.073 *** (0.016)	−0.025 *** (0.009)
<i>Within-R2</i>	0.530	0.641	0.454	0.659	0.506	0.636	0.548	0.479
Regression results for different institutional qualities.								
	FDL* <i>fdd</i>		FDL* <i>ptc</i>		LSE* <i>rdi</i>		LSE* <i>cii</i>	
	Low	High	Low	High	Low	High	Low	High
<i>Inst</i>	1.545 *** (0.121)	2.010 *** (0.244)	−0.270 *** (0.010)	−0.029 *** (0.003)	0.034 *** (0.013)	−0.086 *** (0.012)	0.082 *** (0.007)	−0.026 *** (0.005)
<i>Inst*Hete</i>	−0.034 (0.089)	0.992 *** (0.252)	0.014 (0.010)	0.025 *** (0.008)	0.002 *** (0.000)	0.004 *** (0.001)	0.001 (0.006)	0.013 *** (0.004)
<i>Within-R2</i>	0.281	0.342	0.281	0.342	0.266	0.346	0.264	0.344

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

Second, due to the interrelationship between institutional quality and industries' exports [1,22], the endogenous problem might remain in the regression estimations, although the first-order lagged variation for institutional quality is used to partially relieve the endogenous problem in the empirical analyses above. Acemoglu et al. [1] point out that the institution is an endogenous variable

in the empirical analyses of relations between institutional and economic behaviors. Moreover, Levchenko [2] also concludes that a country's openness to trade would affect the quality of the institution, and countries strive to develop advantageous industries through competitions in improving institutional quality. However, it is a challenge to find appropriate instrument variables for institutional quality. To resolve the potential endogenous problem, we select the one-order-lagged institutional quality as the instrument variable, and we conduct the two-stage-least-square regression estimations. The main results for the instrumental variable method are presented in Table 7. Overall, the results of Table 7 are in line with the regression results of Section 4 although the significance of some variables' coefficients has changed slightly in Table 6.

**Table 7.** Regression results for the instrumental variable method.

Regression results of financial development affecting heterogeneous industries' exports								
	FDL* <i>fdd</i>				FDL* <i>ptc</i>			
	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>Inst</i>	0.407 *** (0.051)	0.372 ** (0.178)	0.893 *** (0.060)	0.801 *** (0.042)	0.508 *** (0.051)	0.636 *** (0.166)	1.226 *** (0.222)	1.834 *** (0.306)
<i>Inst*Hete</i>	3.295 *** (0.296)	0.950 (0.763)	0.184 (0.140)	−0.098 *** (0.024)	0.288 *** (0.019)	−0.123 * (0.066)	−0.198 *** (0.071)	−0.324 *** (0.085)
<i>Within-R2</i>	0.473	0.495	0.576	0.618	0.498	0.571	0.643	0.434
Regression results of the legal system affecting heterogeneous industries' exports								
	LSE* <i>rdi</i>				LSE* <i>cii</i>			
	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level	Low-Level	Middle-Low-Level	Middle-High-Level	High-Level
<i>Inst</i>	0.611 ** (0.239)	0.990 *** (0.291)	2.191 *** (0.355)	0.228 (0.370)	0.698 *** (0.037)	0.632 *** (0.062)	0.297 *** (0.049)	1.178 *** (0.054)
<i>Inst*Hete</i>	0.022 (0.015)	0.112 *** (0.018)	−0.079 *** (0.021)	−0.038 ** (0.019)	0.083 (0.207)	1.905 *** (0.223)	1.885 *** (0.142)	−0.596 *** (0.141)
<i>Within-R2</i>	0.562	0.662	0.483	0.673	0.533	0.697	0.602	0.540
Regression results for different institutional qualities.								
	FDL* <i>fdd</i>		FDL* <i>ptc</i>		LSE* <i>rdi</i>		LSE* <i>cii</i>	
	Low	High	Low	High	Low	High	Low	High
<i>Inst</i>	0.949 *** (0.044)	0.090 *** (0.022)	1.016 *** (0.067)	0.171 *** (0.030)	0.993 *** (0.147)	4.462 *** (1.449)	1.550 *** (0.080)	5.015 *** (0.255)
<i>Inst*Hete</i>	0.066 (0.050)	0.076 *** (0.014)	−0.015 (0.023)	0.039 *** (0.008)	0.030 *** (0.007)	0.344 *** (0.046)	0.182 (0.132)	0.276 ** (0.126)
<i>Within-R2</i>	0.266	0.338	0.266	0.337	0.256	0.120	0.253	0.201

Note: The standard errors are in parentheses. \* denotes significance at 10%, \*\* at 5%, \*\*\* at 1%.

## 6. Conclusions

### 6.1. Main Conclusions

This paper sheds light on the effects of institutional quality on the sustainable development of heterogeneous industries' exports, and after theoretical and empirical analysis, this paper concludes that: (a) Industries with higher financial dependence degrees or higher product technical complexities have export comparative advantages in better financial environments; (b) Industries with higher R&D intensities or higher concentrations of intermediate inputs have export comparative advantages in a better legal environment; (c) The differences in the level of financial development or in the efficiency of legal system would influence the effects of interaction between institutional quality and industry heterogeneity on the sustainable development of industries' exports.

This study shows that institutional quality does promote the sustainable development of industries' exports in emerging countries, while the dynamic comparative advantages of heterogeneous industries are an adaptive response to the institutional environment for emerging countries.

For emerging countries such as China, although institutional quality such as financial development level or legal system efficiency has been a source of industries' comparative advantage, the present level of institutional quality only promotes the export of industries with relatively lower financial dependence degrees, product technology complexities, R&D intensities, or concentrations of immediate inputs, but it hardly boosts the exports of industries with the opposite characteristics. Most directly, institutional quality remains a bottleneck in the process of export structure optimization for emerging economies such as China.

This paper contributes to the literature, since it is the first paper to investigate the relation between institutional quality and the sustainable development of industries' exports for emerging countries from a comprehensive perspective of multiple institutional environments and multi-dimensional industries' heterogeneity. Moreover, this paper provides new evidence that institutional quality does promote the sustainable development of exports in emerging countries. New findings also can be drawn in this study, which is that in emerging countries, the relation above might exhibit different features for different institutional qualities or for different industries' heterogeneity.

### *6.2. Policy Implications*

This study has some implications for building new institutional comparative advantages and for seeking new driving forces for the sustainable development of industries' exports in emerging countries. In order to improve the industries' exports, the following measures could be adopted for emerging countries. First of all, an emerging country could take effort to cultivate institutional comparative advantages through the consolidation of institution construction, and optimizing soft investment environment. Though emerging countries have a long way to construct perfect systems, it is still an urgent matter to promote the improvement of domestic institutional environments, especially to enhance the efficiency of institution enforcement. The low efficiency of institutions for the emerging country is mainly due to the inefficient implementation of institutions, or the irrationality of existing rules and regulations. The feasible strategies are generally as follows: to dynamically optimize the existing system, to improve the performance appraisal system of institution executors, to increase openness in wider fields, to strengthen market mechanism, and so on. Moreover, governments of emerging countries should also take enough effort to construct more favorable institutional environments to promote sustainable exports of industries with high heterogeneity, and thus to achieve the improvement of export structure. In an institutional environment, which is imperfect and cannot be improved in the short term, for an emerging country devoting to improving the industries' exports, a practical and feasible way is to accurately identify the industries' heterogeneity, and to provide related policy support from governments for the industries. Meanwhile, external institution construction still needs to go hand-in-hand with general economic and social reforms.

### *6.3. Limitations and Future Directions of the Study*

Objectively, there are also some limitations of this study. First, as a study exploring the relation between institutional quality and the sustainable development of industries' exports for emerging countries, this paper only selects typical formal institutions for study, and more informal institutions, such as culture feature, could also be seen as important dimensions of institution to explore the relation above. Second, due to the structure of data, this paper only empirically inspects the changes of the overall institutional quality of an emerging country over the years without enough consideration of the possible wide variation of the institutional environment in different regions for an emerging country.

Future research on this topic looks promising in the following directions. First, more types of institutions, such as political systems or culture features, can be applied to thoroughly explore the underlying mechanisms of institutional quality affecting the sustainable development of exports, especially for emerging countries in which domestic institutions are imperfect, due to the inefficient implementation of the institution. Second, in view of the fact that there is an unbalanced development among different regions for an emerging country, more relevant studies can also be designed, based on

the different states or provinces for an emerging country. Besides, more emerging countries can be selected for similar studies to obtain new evidence for the relation above.

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