International Journal of Advanced Social Studies
ISSN: 3006-1776 (Print), 3006-1784 (Online)

Article History
Received: September 02, 2025
Revised: November 23, 2025
Accepted: December 05, 2025
Published: December 12, 2025

*Corresponding Email:
baber.amin@iiu.edu.pk

https://doi.org/10.70843/ijass.2025.05306

Research Article

Technological Diffusion, Absorption Capacity and Export Performance: An Empirical Analysis from the Selected Developing Countries

Baber Amin *, Mirajul Haq and Tauqir Iftikhar
International Institute of Islamic Economics (IIIE), International Islamic University, Islamabad, Pakistan

Abstract

A country's absorption capacity plays a key role in attracting technological diffusion and improving its export performance. This study aims to investigate the role of technological diffusion and absorption capacity in expanding export performance in developing countries. The study uses panel data from developing countries from 2000 to 2020. The results of the fixed-effect analysis reveal a significant, positive role for both technological diffusion and absorption capacity in a country's export performance. The inflow of technology into a country results in technology spillovers and the transfer of advanced knowledge and skills into production. This advanced technology and production knowledge boost both productive capacity and volume, enabling countries to increase exports. Moreover, absorption capacity plays a key role in increasing export performance in developing countries. The results of the study indicate that technological diffusion positively affects export performance initially as absorption capacity increases. Unfortunately, absorption capacity in developing countries does not meet world standards, which is why technology adoption and export performance are lower. The study suggests that countries take the necessary measures to improve their absorption capacity by adopting new technologies and increasing exports.

Keywords: Technological diffusion, Absorption capacity, Export performance.

Introduction

Over the past two decades, a substantial body of empirical research has examined the relationship between technology and export performance. This growing literature highlights the critical role of technological adoption, innovation, and firms' internal capabilities in shaping their participation in global markets. Drawing on theoretical insights from Melitz and Redding (2014), scholars increasingly recognize that firm-level heterogeneity in innovation and technological capabilities helps explain cross-country and cross-industry variations in export outcomes (Love & Roper, 2015). As global markets become more integrated and technologically driven, understanding how firms leverage technological advancements to enhance export competitiveness has become a central theme in international trade research. Innovation is widely recognized as a key driver of productivity and long-run economic growth. Technological progress transforms production processes, enhances efficiency, and enables firms to respond more effectively to evolving consumer preferences. Nelson (2015) views technology as a multifaceted and costly resource that, while difficult to generate and integrate, yields significant economic benefits once adopted. Empirical evidence confirms that technology adoption positively influences firms' decision-making and export activities across industries, including manufacturing, telecommunications, transport, and services. As globalization accelerates and consumer markets expand, firms—especially in developing countries must adopt new technologies to remain competitive and meet international quality standards.

Technological diffusion, defined as the spread and adoption of new technologies across countries and industries, is increasingly crucial in determining firms' export performance. The liberalization of trade and the rapid exchange of knowledge across borders facilitate firms' access to advanced technologies, thereby enhancing productivity and competitiveness. However, the benefits of technological diffusion depend on a firm's absorptive capacity, the ability to identify, acquire, adapt, and apply external knowledge. Firms with higher absorptive capacity are better positioned to convert technological inflows into improved performance, including superior export outcomes. Internal factors, such as human capital, R&D investment, organizational learning, and knowledge management systems, shape a firm's absorptive capacity. Lane and Lubatkin (1998) highlight that firms actively engaged in R&D and knowledge exchange typically demonstrate stronger absorptive capabilities, thereby benefiting more from global technological flows. External factors, including innovation systems, institutional quality, infrastructure, and knowledge networks, also play a critical role. Henriques and Sadorsky (1996) shows that firms operating in regions with robust innovation ecosystems exhibit greater absorptive capacity, resulting in stronger export performance.

For developing countries, technological progress is particularly vital as it enhances production efficiency, fosters human capital formation, reduces costs, and supports economic transformation. Studies underscore that technology contributes to the structural shift from low-value agriculture to high-value manufacturing and services, enabling countries such as Malaysia and Taiwan to achieve export-led growth (Srholec, 2007). In global markets characterized by rapid change, advanced technologies and innovation are central to sustaining competitiveness, expanding market access, and fostering resilience to external shocks. Despite these advantages, many developing economies continue to face challenges, including low labor productivity, inadequate technological infrastructure, limited R&D investment, and weak institutional support. These constraints hinder the absorption and effective use of new technologies, limiting firms' ability to expand their export activities. Moreover, weaknesses in policy frameworks, skills development, and long-term export support further impede firms' competitiveness in global markets.

Understanding how technology diffusion and absorptive capacity jointly influence export performance is therefore crucial for developing economies aiming to strengthen their presence in international trade. While previous studies have provided valuable insights, empirical evidence focusing specifically on developing countries remains limited. This research seeks to address this gap by examining the impact of technological diffusion and absorptive capacity on export performance across selected developing nations. By focusing on export intensity, a continuous and informative measure of export performance, the study aims to identify how technological advancements and firm capabilities shape export outcomes across varying levels of engagement in global markets. The findings are expected to provide significant contributions to the literature and offer policy-relevant insights. In particular, the study emphasizes the need to strengthen national innovation systems, increase R&D investment, develop human capital, and support technology-driven strategies that enable firms to compete effectively in global markets. Ultimately, this research aims to inform policymakers, industry stakeholders, and researchers about the pathways through which technology can foster export growth and drive sustainable economic development in developing countries.

Data and Methodology

Table 1 presents the variables used in the study, along with their definitions, expected signs, and data sources.

Table 1. Description of variables.

Type of Variables	Definitions	Expected Signs	Sources
Dependent Variables			
Export Performance ($EXPit$)	Represented as a percentage of GDP, which serves as a proxy for the overall exports of goods and services.	+	WDI

Core Variables			
Technological Diffusion ($TDit$)	The import of machinery and transport equipment is used as a proxy to capture the impact of technological diffusion on export performance	+	UN COMTRADE statistic
Absorption Capacity ($OBCit$)	a country's ability to recognize the value of new information, assimilate it, and apply it at a group, national, and international level	+	Penn World Tables (PWT, Version 10.0).
Control Variables			
Manufacturing Value Added ($MVAit$)	The manufacturing value added ($MAVit$) within the industrial sector represents the sector's total output and encompasses the value added in mining, large-scale construction, and electricity.	+	WDI
Foreign Direct Investment ($FDIit$)	Net inflows measure foreign direct investment as a % of GDP. It involves technology, capital, and industrial expansion.	+	WDI
Real Effective Exchange Rate ($REERit$)	The value of a currency against a weighted average of multiple foreign currencies, by a price deflator or cost index	-	WDI

Theoretical Background

This study explores the relationship between technological diffusion, absorption capacity, and export growth, drawing on endogenous innovation and growth theory influenced by Schumpeter (1983). Although Schumpeter initially presented his theory of the economic function of entrepreneurs in German in 1911, the English translation was published in 1934. Schumpeter aimed to identify the causal processes linking inventive activity to economic progress. In this context, innovation is defined as modifications in manufacturing processes that aim to reduce the cost of goods or services, creating a gap between old and new costs. Innovation can manifest in various forms, such as introducing new technologies, changing production methods, improving machinery or raw materials, adopting new energy sources, or implementing more effective sales tactics.

As shown in Figure 1 the Schumpeterian trilogy, which breaks down the technological transition process into three phases in figure 1 provides a valuable framework. The initial phase is the invention process, which involves developing new ideas. Inventions are often influenced by scientific knowledge and are disseminated over time, often by chance. The second phase is innovation, where novel concepts are transformed into usable goods and procedures. This marks the commercial application of an invention, and the countries producing innovations are determined by their technological and economic environments. The third phase is the diffusion process, during which new equipment, methods, and processes spread among nations.

According to Schumpeterian theory, innovation and diffusion, resulting from the introduction and spread of new production methods and technologies, lead to lower production costs and increased output. These goods are subsequently exported to other countries, benefiting from the host country's enhanced production capabilities, advanced foreign technology, increased competition levels, and established reputation and goodwill in international markets. Absorption capacity plays a vital role in increasing export performance, particularly when technologies diffuse from developed to developing countries. This diffusion leads to value addition in exports, diversification of export products, and a reduction in permanent costs, ultimately improving export performance. The level of absorption capacity, such as human capital, influences the extent to which a country can effectively adopt and utilize international technologies, thus impacting its export levels. Developing countries that can easily adopt international technology experience increased production.

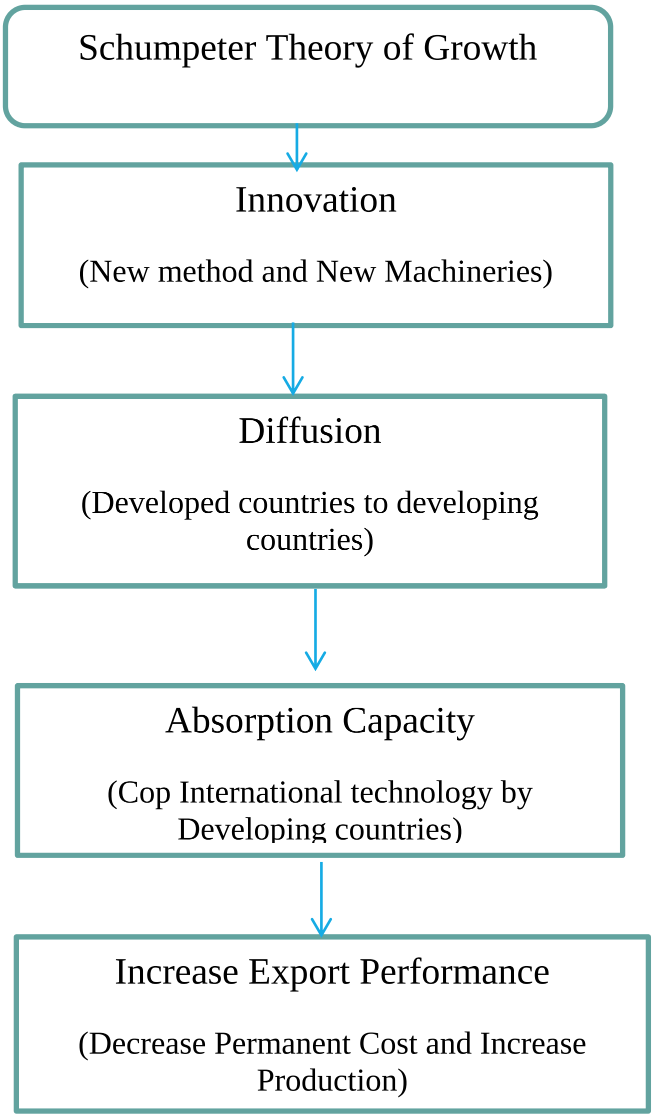

Figure 1. Schumpeter theory of growth.

Empirical Model

This study extended the empirical model developed by Montobbio and Rampa (2005). This model combines components of the technical effect and enhances the analysis of determinants of export growth.

$$EXPit = \beta 0 + \beta 1\, TDit + \beta 2\, OBCit + \beta 3\, (TD * OBC)\, it + \beta\, 4\, MVAit + \beta 5\, FDIit + \beta 6 REERit + \beta 7 GDPit + \mu i + \gamma t + \mathcal{E}it \quad (1)$$

Here i is countries t is years β_0 is intercept (β_1, ……, β_7,) are parameters μi is the random country specific effect due to unobserved exogenous factor γt is Random time effect Ɛit is Radom Error, EXP export performance as percentage of GDP TD technological diffusion as percentage of total import OBC absorption capacity as human capital index MVA manufactured values added as percentage of growth FDI foreign direct investment as percentage of GDP REER real effective exchange rate index GDP as annual percentage.

Estimation Technique

This study employs both fixed effects (FE) and random effects models. The use of panel data spanning 115 developing countries from 2000 to 2020 allows us to control for unobserved heterogeneity and potential endogeneity in the estimation process. Initially, both FE and random effects (RE) models are considered. To choose the appropriate specification, we perform the Hausman test, which compares the consistency and efficiency of RE and FE estimators. A rejection of the null hypothesis (that regressors are uncorrelated with country-specific effects) supports the use of FE (Hausman & Taylor, 1981). We begin with the FE estimator, which controls for time-invariant, unobserved heterogeneity across countries such as geographic, cultural, or historical institutional differences that might otherwise bias the estimates (Fernández-Val & Weidner, 2018; Amin *et al*., 2020). Figure 2 also presents the estimation flowchart.

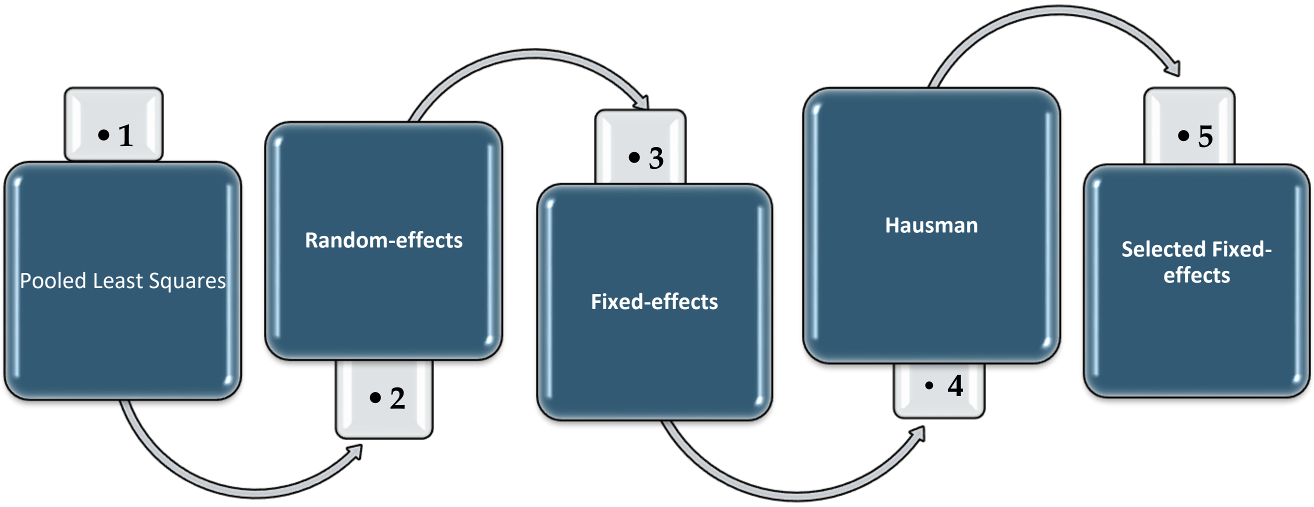

Figure 2. Estimation flowchart.

Results and Discussion

Descriptive Statistics

Table 2 presents the statistical summary of the variables used in the empirical models. The table includes the mean, maximum, minimum, standard deviation (Std. Dev.), skewness, and kurtosis values for all variables.

Table 2. Summary statistics.

Variables	$EXPit$	$TDit$	$OBCit$	$MVAit$	$FDIit$	$REERit$	$GDPit$
Mean	1.4636	.0232	.3441	1.0448	.3797	1.8446	.5015
Maximum	2.0784	1.9178	.5578	1.6979	1.5092	2.7084	1.4218
Minimum	.6579	-1.6448	.1420	.53378	-2.6778	.8382	-1.3425
Std. Dev.	.2350	.7617	.1329	.3039	.4794	.5236	.3649
Skewness	-.3905	3.4736	-.8135	-1.7828	-1.9421	-3.1633	-1.0420
Kurtosis	3.4736	2.4137	3.1205	6.7382	10.2337	11.3174	4.6771

Source; Author's own calculations.

Diagnostic Test

The Hausman test, developed by Hausman (1978), is a commonly used model selection tool. Based on the Hausman test, which yielded a p-value of 0.0633, there is some evidence against the null hypothesis. Before running the regressions, all the Hausman tests indicated the use of fixed effects models. This implies that there are unobserved variables that are correlated with both the independent variables and the error term in the model. By employing fixed-effects models, we can control for unobserved variables and mitigate omitted-variable bias (Haq et al., 2017).

Fixed Effects Results

To estimate our model, we used a panel-data fixed-effects model. The interpretation of the results is based on the fixed-effect model, as the Hausman specification test (Hausman, 1978) indicated that it is the best fit for this study.

Table 3. Fixed Effects Results

EXP(Ind)	Coefficient.	Std. Error	T-vale	P-vale
TD_{it}	.102***	.019	5.45	0.000
OBC_{it}	.125***	.043	2.92	.004
TD_{it}*OBC_{it}	-.046***	.017	-2.72	.007
MVA_{it}	.036**	.015	2.36	.019
FDI_{it}	.015*	.009	1.76	.079
$REER_{it}$	-.314***	.048	-6.61	0.000
GDP_{it}	.045***	.009	5.12	0.000
Constant	1.948***	.09	21.70	0.000
F-test	151.986			
Prob	0.000			

Source: Author's own calculations ***, **, and * show significance at 1%, 5% and 10% level of significance, respectively.

The results presented in Table 3 show the impact of demonstrating significant relationships between the dependent variable, exports($EXPit$), and the independent variables in our model. The relationship between technological diffusion and exports is significant and positive. This finding suggests that the adoption and dissemination of technology have a positive impact on export performance. This is consistent with the findings of Márquez-Ramos and Martínez-Zarzoso (2009), who also discovered a positive relationship between technology advancements and export performance, highlighting the importance of technology in global trade.

The association between absorption capacity ($OBCit$) and exports ($EXPit$) remains significant and positive. This suggests that a country's ability to adopt and apply new technology effectively positively affects its export performance. This finding aligns with the research conducted by Ahimbisibwe et al. (2016), which also demonstrated a favorable effect of absorption capacity on exports. Furthermore, the interaction between technological diffusion ($TDit$) and absorption capacity ($OBCit$) yields a negative and significant result. These findings suggest that while absorption capacity may amplify the effects of technological diffusion, there are diminishing returns to this interaction for export performance. The diminishing benefits of ($OBCit$) in relation to the effects of (TD) highlight the complexities involved in achieving optimal export performance.

The results indicate a significant and positive relationship between mexports open values added ($MVAit$) and exports($EXPit$).This highlights the critical role played by the manufacturing industry in driving export expansion. Montobbio and Rampa (2005) have also established a positive correlation between manufacturing value added and exports. Similarly, foreign direct investment ($FDIit$) eibits a positive and significant association with($EXPit$). This suggests that inflows of foreign direct investment enhance export performance. Various studies, including Grossman and Helpman (2015) have provided evidence supporting ($FDIit$) as a determinant of a host country's exports.

The real effective exchange rate ($REERit$) is found to have a significant and negative association with exports($EXPit$). This suggests that a higher exchange rate can negatively affect a country's export competitiveness. Their results also indicate that the real effective exchange rate (RERit) negatively affects exports. On the other hand, a positive and highly significant relationship is observed between gross domestic product ($GDPit$) and exports($EXPit$). This highlights the importance of overall economic expansion in boosting export performance.

The model is highly significant, as evidenced by the F-test result of 23.265 and the p-value of 0.000. This indicates that the overall model is statistically significant, implying that the independent variables collectively explain a significant portion of the variation in exports.

Breusch and Pagan's test is used to detect heteroscedasticity in a regression model. The null hypothesis for this test is that there is no heteroscedasticity of any order up to "p". The test result yields a p-value of 0.0000, indicating strong evidence against the null hypothesis. This suggests heteroscedasticity in the regression model.

Conclusions

In conclusion, this study examined the impact of technological diffusion and absorption capacity on export performance in developing countries' economies. The study used a panel data analysis approach covering the 21-year period from 2000 to 2020. The model incorporated various independent variables, including technological diffusion, absorption capacity, manufacturing value added, foreign direct investment, real effective exchange rate, and GDP, while controlling for other relevant factors. The study's findings demonstrate that both technological diffusion and absorption capacity have significant, positive effects on the export performance of developing countries. Technological diffusion emerged as a key driver of international competitiveness, offering favorable opportunities for engaging in foreign markets. The results indicate that countries with higher levels of technological diffusion are more likely to initiate and expand their exports. The adoption of modern transportation and machinery technologies has had a positive effect on export performance. Moreover, the study emphasizes the critical role of absorption capacity in expanding exports for developing countries. Absorption capacity, encompassing factors such as human capital and a conducive business environment, plays a vital role in enabling the effective use of technology. Without accounting for absorption capacity, it becomes difficult to comprehend the impact of technological diffusion on export expansion fully. Developing countries, with their advanced technology and abundant raw materials, are attractive to multinational companies seeking higher profits. To benefit from technological diffusion and promote exports, effective absorption capacity is essential. Improved absorption capacity enables investors to conduct business activities efficiently and at lower costs, leading to increased production and exports.

Based on the analysis, the findings suggest that both technological diffusion and absorption capacity initially have positive impacts on export performance. However, the negative interaction term indicates that over time, the joint effect of these factors on export performance becomes less favorable. Therefore, it can be inferred that in the early stages of implementing technological diffusion policies and enhancing absorption capacity, there is a positive influence on export performance. However, as time passes, the interaction between technological diffusion and absorption capacity begins to negatively affect export performance. This highlights the importance of considering the long-term effects and potential limitations of relying solely on technological diffusion and absorption capacity as drivers of export performance.

Based on the results of this study, several policy recommendations can be made to promote export performance in developing countries:

1. Enhance Technological Diffusion: Governments should prioritize initiatives to enhance technological diffusion in developing countries. This can be achieved by promoting investments in research and development, providing incentives for technology transfer, and fostering collaborations between domestic firms and international technology providers. By facilitating the adoption of modern technologies and machinery, countries can improve their global competitiveness and increase export potential.
2. Developing countries should establish partnerships and collaboration frameworks with technologically advanced countries or multinational corporations to facilitate the transfer of technology. This can be done through technology licensing, joint ventures, and knowledge-sharing agreements.
3. Governments should prioritize investments in education and skill development programs to enhance the human capital base. This includes improving primary, secondary, and tertiary education systems, as well as vocational training and lifelong learning initiatives.

4. Establishing mechanisms to facilitate the transfer of knowledge and expertise among industry players, research institutions, and universities can enhance absorption capacity. Encouraging collaboration and networking platforms can facilitate the dissemination and utilization of knowledge.

References

Ahimbisibwe, G. M., Nkundabanyanga, S. K., Nkurunziza, G., & Nyamuyonjo, D. (2016). Knowledge absorptive capacity: do all its dimensions matter for export performance of SMEs?. World Journal of Entrepreneurship, Management and Sustainable Development, 12, 2.

Amin, B., Ul-Haq, H., & Bhatti, A. (2020). Socioeconomic and Political Determinants of Public Spending Allocations: A Panel Data Analysis of Aggregate and Sectoral Spending. Pakistan Social Sciences Review, 4(I), 1072–1085.

Fernández-Val, I., & Weidner, M. (2018). Fixed effects estimation of large-T panel data models. Annual Review of Economics, 10(1), 109-138.

Grossman, G. M., & Helpman, E. (2015). Globalization and growth. American Economic Review, 105(5), 100-104.

Haq, M., Perveen, K., & Amin, B. (2017). Trade Liberalization, Manufacturing Value Addition, and Economic Growth: Empirical Evidence in Case of Pakistan. Forman Journal of Economic Studies, 13, 83-10

Hausman, J. A. (1978). Specification tests in econometrics. Econometrica: Journal of the Econometric Society, 1251-1271.

Hausman, J. A., & Taylor, W. E. (1981). Panel data and unobservable individual effects. Econometrica: Journal of the Econometric Society, 1377-1398.

Henriques, I., & Sadorsky, P. (1996). Export-Led Growth or Growth-Driven Exports? The Canadian Case. Canadian Journal of Economics, 29(3), 540-55.

Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. Strategic Management Journal, 19(5), 461-477.

Love, J. H., & Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. International Small Business Journal, 33(1), 28-48.

Márquez-Ramos, L., & Martínez-Zarzoso, I. (2009). The effect of technological innovation on international trade: a nonlinear approach. Economics discussion paper, (2009-24). https://www.degruyterbrill.com/document/doi/10.5018/economics-ejournal.ja.2010-11/downloadAsset/suppl/journalarticles_2010-11-sm1.pdf.

Melitz, M. J., & Redding, S. J. (2014). Heterogeneous firms and trade. Handbook of International Economics, 4, 1-54.

Montobbio, F., & Rampa, F. (2005). The impact of technology and structural change on export performance in nine developing countries. World Development, 33(4), 527-547.

Nelson, R. R. (2015). The rate and direction of inventive activity: Economic and social factors. Princeton University Press.

Schumpeter, J. A. (1983). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (Vol. 55). Transaction publishers.

Srholec, M. (2007). High-tech exports from developing countries: A symptom of technology spurts or statistical illusion?. Review of World Economics, 143(2), 227-255.