Uluslararası Akademik Birikim Dergisi
Yıl: 2024, Cilt: 7, Sayı 5, ss.961-967

İşgücü Verimliliği ve Yüksek Teknoloji Ticareti: Türkiye Örneği

Maya MOALLA
Dr., Turkiye
mayamoalla@hotmail.com
https://orcid.org/0000-0003-4076-2790

Seyit Ali MİÇOOĞULLARI
Assoc. Prof., Kilis 7 Aralık Üniversitesi,
s.alimicoogullari@kilis.edu.tr
https://orcid.org/0000-0001-9266-1559

Makale Başvuru Tarihi : 05.11.2024
Makale Kabul Tarihi : 23.12.2024
Makale Yayın Tarihi : 31.12.2024
Makale Türü : Araştırma Makalesi
DOİ: 10.5281/zenodo.14583392

Anahtar Kelimeler:

İşgücü verimliliği, teknolojik değişim, Fourier Shin,

Özet

Bu çalışma, 2004-2022 yılları arasında Türkiye'de işgücü verimliliği büyümesi ile yüksek teknoloji ticareti arasındaki ilişkiyi, Türkiye İstatistik Kurumu ve Dünya Bankası'ndan elde edilen yıllık verilerle incelemektedir. Yüksek teknoloji ticaret endeksi, yüksek teknoloji ihracat ve ithalat payları temel alınarak Temel Bileşenler Analizi (PCA) ile oluşturulmuştur; işgücü verimliliği ise zincirlenmiş hacim GSYH'sinin tam zamanlı eşdeğer istihdamına oranı olarak hesaplanmıştır. Ng & Perron ve Elliott et al. (ERS) testleri kullanılarak yapılan analizler, değişkenlerde durağanlık olmadığını ortaya koymuştur. Fourier Shin (2016) ve Shin (1994) testlerinin sonuçları karışık cointegrasyon kanıtları sunmaktadır: Shin testi uzun dönemli bir ilişki olmadığını öngörürken, Fourier Shin testi incelenen değişkenler arasında cointegrasyon olduğunu göstermektedir.

The nexus between Labor Productivity and High-Technology Trade: Insights from Turkiye

Keywords:

Labor productivity, technological change, Fourier Shin

Abstract

This study explores the relationship between labor productivity growth and high-technology trade in Turkiye from 2004 to 2022, utilizing annual data from the Turkish Statistical Institute and the World Bank. The high-technology trade index was constructed via Principal Component Analysis (PCA) based on the shares of high-tech exports and imports, while labor productivity was calculated as the ratio of chained volume GDP to full-time equivalent employment. Utilizing Ng & Perron and Elliott et al. (ERS) tests, the results revealed non-stationarity in the variables. The results of Fourier Shin (2016) and Shin (1994) provide mixed cointegration evidence: while the Shin test suggests no long-term relationship, the Fourier Shin test indicates cointegration between the studied variables.

1. INTRODUCTION

The economic research deals with the nexus between labor productivity growth and high-technology trade, particularly in emerging economies. Incorporating both exports and imports, high-technology trade is considered a key driver of innovation diffusion, technological advancement, and productivity enhancements. From the economic performance perspective, labor productivity is influenced by the ability of economies to integrate high-technology goods into production processes and export them to competitive global markets. A strong relationship between high-technology trade and productivity growth is identified in the economic theoretical and empirical studies. High-technology exports reflect an economy's capacity to produce and market cutting-edge products, often signaling robust innovation capabilities and competitiveness; conversely, imports of high-technology products facilitate knowledge transfer and technological spillovers, enabling domestic firms to adopt advanced production techniques and improve efficiency. Keller (2004) and Coe & Helpman (1995) highlight that technology diffusion through trade channels is crucial in productivity improvements in developing economies. Turkiye has recently focused on growth strategies driven by high-tech trade, restructuring its industrialization and foreign trade policies to increase the production and export of high-value-added products. High-tech exports hold critical importance for countries' economic development and achieving international competitive advantage (Akay, 2021; Kalkan & Pala, 2022), demonstrating the positive effects of increased production and export of high-tech products on labor productivity (Akyol & Demez, 2020; Durgun & Çapik, 2018). Few studies in the existing literature address the relationship between high-tech exports and labor productivity, representing a significant gap in evaluating the effectiveness of Turkiye's economic growth strategies (Meçik & Afşar, 2014; Şeker, 2018). In particular, research is needed to explore the long-term effects of increased production and export of high-tech products on labor productivity (Akyol & Demez, 2020; Durgun & Çapik, 2018). Moreover, considering Turkiye's industrial and foreign trade policies is crucial. Significant growth in the production and export of high-tech products is achieved alongside improving labor productivity, underscoring the success of Turkiye's growth strategies based on high technology (Şeker, 2019). Furthermore, foreign direct investments' impact on high-tech exports must be taken into account, as FDI enhances Turkiye's capacity for producing high-tech products, thereby positively influencing labor productivity (Topallı, 2015). From another point of view, the nexus between Turkiye's high-tech imports and labor productivity is another important issue for the country's economic development and growth. High-tech imports play a significant role in Turkiye's technological development and the enhancement of its production capacity (Çakmaklı & Şarkgüneşi, 2023; Şeker, 2018) since high-tech products entering the country through foreign direct investments and technology transfer elevate Turkiye's technology level and increase its high-tech exports (Çakmaklı & Şarkgüneşi, 2023; Şeker, 2018), positively affecting labor productivity (Çakmaklı & Şarkgüneşi, 2023). However, some studies indicate that the country's technological capabilities are insufficient, hindering the effective internalization of technology transfer, and ultimately limiting the growth of high-tech exports (Demirtaş & Aktop, 2018), therefore, it is essential to develop a skilled workforce through education and training programs to enhance labor productivity (Olcay, 2023; Özdemir et al., 2022). Additional challenges such as the slow pace of technological transformation in Turkiye's manufacturing sector, the relatively small share of advanced technology exports, and the dominance of low and medium-low-tech exports continue to hamper labor productivity (Başkol & Bektaş, 2020; Konak, 2018). Building on this, this paper investigates the nexus between labor productivity growth and a composite high-technology trade index in Turkiye during the period spanning from 2004 to 2022, which was reconstructed utilizing Principal Component Analysis (PCA) based on two variables: the share of high-technology exports in total exports and the share of high-technology imports in total imports. Ng & Perron (2001) and Elliott et al. (1996) unit root tests were used to assess the stationarity of the employed series, along with utilizing advanced econometric techniques, including the Fourier Shin test (Tsong et al., 2016) and the Shin test (1994) to examine the long-run relationship between labor productivity and high-technology trade. Empirical reveals evince the existence of a significant long-run nexus between the analyzed variables. The potential contributions of this study to the existing literature are demonstrated by: i) extending the understanding of how technological trade dynamics influence labor productivity in an emerging economy like Turkiye by utilizing a composite high-technology trade index that considers both imports and exports and, to the best of our knowledge it is the first work that investigates this relationship employing the high-technology trade index, and ii) highlighting the significance of including Fourier components to capture structural breaks better following Tsong et al. (2016). This study is organized as follows: the first segment provides an introduction, the second reviews the literature, the third presents the data methodology and empirical application, and the final section discusses the conclusions.

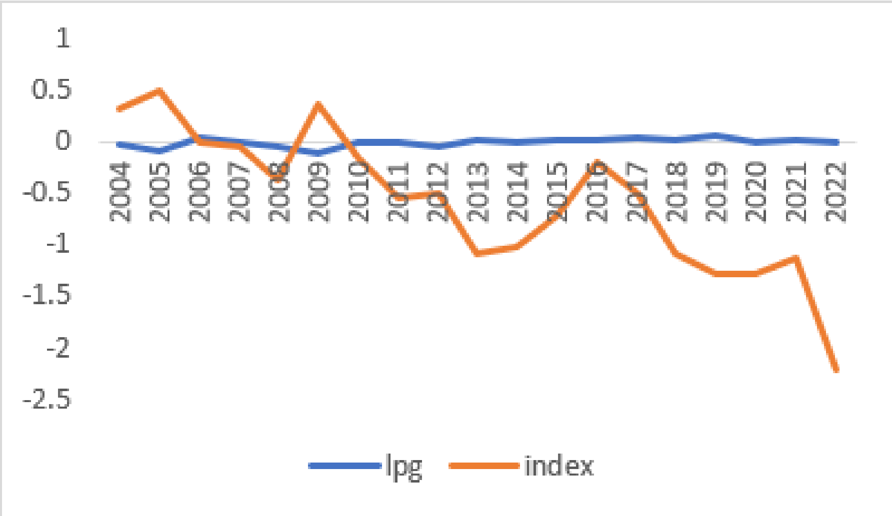
2. LITERATURE REVIEW

Various theoretical lenses analyzed the relationship between labor productivity and high-technology trade. Each of them offers insights into how technological advancements and trade flows impact productivity growth. Endogenous growth theory, pioneered by Romer (1990) and Lucas (1988), plays a central role in understanding this relationship, positing that innovation, human capital, and technological progress are key drivers of long-term economic growth and productivity improvements. Firms can enhance their production processes, leading to increases in labor productivity, by gaining access to advanced technologies and knowledge through high-technology trade, which facilitates the exchange of innovative products and knowledge, acting as a conduit for the transfer of cutting-edge technologies across borders. The high-technology trade contribution to productivity growth is further explained by the technology spillover theory (Grossman & Helpman, 1991). The diffusion of technology is accelerated by the high-technology trade, as countries and firms exposed to foreign innovations can adopt, adapt, and improve upon them. Firms can improve their production techniques by learning from the technology embedded in the imported products; in turn, high-technology exports mirror a country's innovation capabilities, contributing to productivity growth through increased technological competence and specialization in high-tech sectors. Ricardo's comparative advantage theory (1817) provides a classical framework for understanding the nexus between trade and productivity, indicating that countries should specialize in producing goods in which they hold a comparative advantage, thereby improving efficiency and maximizing output. Accordingly, specialization in high-technology sectors leads to the accumulation of expertise, economies of scale, and productivity gains as the labor force becomes increasingly skilled in these sectors, contributing to higher productivity per worker. Moreover, countries engaged in high-technology trade can leverage their specialization to foster further productivity improvements as global demand for high-tech products increases. From another point of view, Gereffi et al. (2005) demonstrate that countries gain access to advanced technologies, best practices, and international standards as they integrate into global value chains. Such integration allows firms to specialize in specific tasks within the production process, improving efficiency and labor productivity. Becker (1964) underscores that skilled labors play a critical role in adopting and effectively utilizing high technologies. As countries engage in high-technology trade, the demand for skilled workers capable of operating advanced machinery, utilizing cutting-edge technologies, and driving innovation grows, prompting investments in education, training, and skill development, which in turn creates a feedback loop where the availability of skilled labor further enhances the ability of firms to adopt new technologies and boost productivity. Finally, the economic literature demonstrates that high-technology trade is a crucial ingredient that drives labor productivity by enabling technological diffusion, knowledge spillovers, and innovation, especially in developing economies aiming to achieve long-term economic advancement.

3. DATA, METHODOLOGY, AND EMPIRICAL APPLICATION

This paper investigates the nexus between labor productivity growth (lpg) and high-technology trade (index) in the Turkish economy during the period spanning from 2004 to 2022, utilizing annual data from the Turkish Statistical Institute, including chained volume GDP and employment figures, along with high-technology trade data from the World Bank database. The high-technology trade index is constructed using Principal Component Analysis (PCA) based on two variables: the share of high-technology exports in total exports and the share of high-technology imports in total imports. Labor productivity is calculated by dividing chained volume GDP by the total full-time equivalent employment. Figure (1) shows the variables. The data reveals fluctuating trends in lpg and the index over the years (corr. -0.53). While labor productivity growth remains negative or low, some years show positive high-tech trade index values. A robust econometric framework was adopted in this study to investigate the relationship between labor productivity and high-technology trade. Initially, the stationarity of the employed series is evaluated using Ng & Perron (2001) test designed to address the limitations of traditional tests like the Augmented Dickey-Fuller (ADF), employing Generalized Least Squares (GLS) detrending for improved size and power properties. Ng & Perron (2001) test offers greater reliability in small sample sizes and robustness against structural breaks, making it suitable for real-world data.

Figure (1): Variables.



Furthermore, the Elliott et al. (1996) test, which also employs GLS detrending and a Point-Optimal likelihood ratio, is utilized since it improves the accuracy of unit root detection by minimizing finite-sample distortions, making it a powerful choice for small-sample sizes or when data exhibits complex characteristics. Table (1) presents the results of the unit root tests.

Table (1): Results of Unit root tests (with Constant and Trend):

		lpg				Index			
		Test Statistic	Critical Values			Test Statistic	Critical Values		
			1%	5%	10%		1%	5%	10%
ERS Test	ERS Test	9.757	4.220	5.720	6.770	10.091	4.220	5.720	6.770
MGLS Test	MZa	-8.620	-23.80	-17.30	-14.20	-8.713	-23.8	-17.3	-14.2
	MZt	-2.014	-3.420	-2.910	-2.620	-1.878	-3.42	-2.91	-2.62
	MSB	0.234	0.143	0.168	0.185	0.216	0.143	0.168	0.185
	MPT	10.756	4.030	5.480	6.670	11.084	4.03	5.48	6.67

Table (1) presents the unit root tests' results for the variables lpg and index, evaluating stationarity against critical values at the 1%, 5%, and 10% significance levels. ERS test's statistic for lpg (9.757) exceeds all critical values, indicating that the null hypothesis of a unit root cannot be rejected at any significance level, suggesting non-stationarity. The test statistic for the index (10.091) is similarly higher than the critical values, failing to reject the null hypothesis. Furthermore, both lpg and index yield MZa, MZt, MSB, and MPT values that fall outside critical thresholds when utilizing the MGLS Test, reinforcing non-stationarity in the data. The unit root tests' results indicate a lack of stationarity in the analyzed variables.

The second step is to conduct cointegration tests to identify long-run relationships between non-stationary series integrated of the same order. The results of the cointegration test on the long-run relationship between labor productivity growth and the technology trade utilizing Fourier Shin (Tsong et al., 2016) and Shin test (Shin, 1994) are presented in Table (2). Table (2) presents the cointegration results, indicating varying outcomes depending on the estimation method and test applied. Under the Fourier Shin test, the OLS model suggests strong evidence of cointegration since the F-statistic of 2.610 exceeds all critical values at the 1%, 5%, and 10% levels.

Table (2): Cointegration Results

	Fourier Shin			Shin (constant and trend)		
	F-Stat	Freq.	CIf			Test Stat.
OLS:	2.610	1	0.043			0.081
DOLS:	1.537	3	0.088			0.023
	Critical Values:					
	1%	5%	10%	1%	5%	10%
OLS:	0.507	0.304	0.224	0.184	0.121	0.097
DOLS:	0.507	0.304	0.224	0.184	0.121	0.097

In contrast, the DOLS model indicates weaker evidence of cointegration compared to OLS, with an F-statistic of 1.537, which only surpasses the 10% critical value. The results of the Shin test reveal that both OLS and DOLS have test statistics (0.081 and 0.023, respectively) below their corresponding critical values, implying no cointegration in either model according to this test. Thus, while the Shin test indicates no cointegration for both methods, the Fourier Shin test suggests cointegration for OLS, highlighting the significance of including Fourier components to better capture structural breaks in the deterministic trend. The Dynamic Least Squares (DOLS) and Fully Modified Least Squares (FMOLS) models were employed to assess the long-run relationships between the variables. The results were reported in table (3).

Table (3): Coefficient estimation reveals

	DOLS	FMOLS
INDEX	-0.133407 (t = -20.79, p = 0.0002)	-0.034679 (t = -2.47, p = 0.0251)
Constant (C)	-0.093847 (t = -15.83, p = 0.0005)	-0.029541 (t = -2.33, p = 0.0331)

The coefficient of INDEX is -0.1334, which suggests that a one-unit increase in INDEX is associated with a 0.1334 decrease in LPG in the long run, holding other factors constant. This negative relationship indicates that as the INDEX increases, LPG consumption tends to decrease. Furthermore, the Fully Modified Least Squares (FMOLS) model indicates a weaker fit. The coefficient of INDEX is -0.0347, which is statistically significant at the 5% level (p-value = 0.0251). Although the relationship is negative, it is less pronounced than in the DOLS model. This suggests that while there is a significant long-run relationship between INDEX and LPG, the magnitude of the effect is smaller compared to the DOLS model. The negative nexus between labor productivity growth and a high-tech trade index, constructed from high-tech exports and imports, can be attributed to factors such as a) technological dependence (Kavacık, 2023) without sufficient domestic innovation, where reliance on high-tech imports limits productivity gains and hinders local capability development, b) trade imbalances, characterized by high-tech imports exceeding exports, could stifle local industries and signal a lack of competitiveness, c) inadequate absorption of high-tech innovations prevent the effective integration and utilization of advanced technologies due to workforce skill gaps, d) Structural changes, such as job displacement caused by an influx of high-tech imports, can slow productivity growth in the short term and disrupt traditional industries, e) prioritizing low-value high-tech products with minimal knowledge transfer reduces the potential impact on labor productivity. Samaniego (2006) explains that when new technologies conflict with old ones, there is an initial slowdown in productivity followed by recovery, with outcomes varying by establishment age and capital, highlighting that productivity slowdowns can arise from the incompatibility of old expertise with new techniques

4. CONCLUSION

This paper examines the nexus between labor productivity growth and high-technology trade in Turkiye from 2004 to 2022, demonstrating a negative long-run relationship between the variables. Decision-makers should focus on promoting domestic innovation through R&D, technological entrepreneurship, and local industry development. Policies to balance trade flows by boosting high-tech exports and supporting industries affected by technological disruptions with retraining programs and social safety nets will help mitigate short-term productivity losses, ensuring long-term economic growth

REFERENCES

Akay, Ö. (2021). Yüksek Teknoloji İhracatında Türkiye'nin Yeri ve Belirleyicileri. *Düzce Üniversitesi Bilim ve Teknoloji Dergisi*. https://doi.org/10.29130/dubited.861464

Akyol, M., & Demez, S. (2020). İnovasyonun Yüksek Teknoloji Ürün İhracati Üzerindeki Etkisi: Yeni Endüstrileşen Ülkeler İçin Panel Veri Analizi. *Journal of Yaşar University*, *15*(57), 56–62. https://doi.org/10.19168/jyasar.568712

Başkol, M. O., & Bektaş, S. (2020). Türkiye İmalat Sanayinin Teknolojik Yapısının Rekabet Gücü Üzerine Bir Analiz. *TESAM Akademi Dergisi*, 331–356. https://doi.org/10.30626/tesamakademi.788709

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. National Bureau of Economic Research; distributed by Columbia University Press.

Çakmakli, B. M., & Şarkgüneşi, A. (2023). Avrupa Birliği ve ASEAN Çerçevesinde Ekonomik Entegrasyonların Türkiye'nin Teknoloji Transferine Etkisi. *Fiscaoeconomia*, *7*(1), 1–45. https://doi.org/10.25295/fsecon.1118304

Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review*, *39*(5), 859–887. https://doi.org/10.1016/0014-2921(94)00100-e

Demirtaş, G., & Aktop, V. (2018). An Empirical Investigation on Internalization of Technology Transfer in Turkey. *Ekonomik Yaklasim*, *29*(108), 69. https://doi.org/10.5455/ey.16698

durgun, a., & Çapik, E. (2018). Ar-Ge Harcamalari ve Yüksek Teknolojili Ürün Ihracatinin Büyümeye Etkisi: Türkiye Örneği. *Yönetim ve Ekonomi Araştırmaları Dergisi*, 301–314. https://doi.org/10.11611/yead.463205

Elliott, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient Tests for an Autoregressive Unit Root. *Econometrica*, *64*(4), 813. https://doi.org/10.2307/2171846

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Econ* Alfred William, Benn. (2017). *The Greek Philosophers*, vol. I, Diamond Publishers.

Andre Comte, Sponville. A. Compte. (2004). *Büyük Erdemler Risalesi*, Çev. Işık Ergüden. 1. Baskı, İstanbul Bilgi Üniversitesi Yayınları, İstanbul.

Arslan, Topakkaya. (2008). *Adalet Kavramı Bağlamında Platon-Aristoteles Karşılaştırması*, FLSF Dergisi, Cilt: 6, Sayı 6.

Barney, Rachel. (2006). *The Sophistic Movement*, İn M. L. Gill & P. Pellegrin, *A Companion to Ancient Philosophy*, Blackwell.

Badiou, Alain. (2015). *Platon'un Devleti*, Çev. Savaş Kılıç & Nihan Özyıldırım, Metis Yayınları, İstanbul.

Cicero. (2021) *De Officiis*, Arma Virumque, Independently Published, Tufts University.

Eduard, Zeller. (1931). *Outlines of The History of Greek Philosophy*, The International Library of Philosophy, Published by Routledge.

Ernest, Cassirer. (2005). *Devlet Efsanesi*, Çev. Necla Arat, Say Yayınları, 1. Baskı, İstanbul Kasım.
Frank, Thilly. (2010). *Bir Felsefe Tarihi*, Çev. Yasemin Çevik, İdea Halk Kitabevi, İstanbul.
Gürgen, Abrim. (2020). *Erdem Üzerine Tartışmalar*, Doğu Kütüphanesi Yay., İstanbul.
Janet, Coleman. (2000). *A. History of Political Thought; From Ancient Greece to Early Christianity*, Blackwell Publishers, Oxford.
Johann Eduard, Erdman. (1890). *A History of Philosophy/*, vol. I, Ancient and Mediaeval Philosophy.
Karl Raimund, Popper. (1966) *Open Society and Its Enemies*: The Spell of Plato, Vol. I. Princeton University Press.
Küçükalp, Derda. (2016). *Siyaset Felsefesi*. 2. Bs., Dora Yay., Bursa.
Max, Weber. (2015*) History of Philosophy*, Palala Press.
MacIntyre, Alasdair. (1998*). A Short History Of Ethics*: A History of Moral Philosophy from the Homeric Age to the Twentieth Century, 2. Bs., University of Notre Dame Press, Notre Dame, Indiana.
MacIntyre, Alasdair. (2019). *Erdem Peşinde Bir Ahlak Teorisi Çalışması*, Çev. Muttalip Özcan, Vakıfbank Kültür Yay., İstanbul.
Platon. (2012). *Devlet*, Çev. Sabahattin Eyüboğlu- M. Ali Cimcöz, Türkiye İş Bankası Kültür Yay., 12. Bs., Ocak İstanbul.
Plato. (2013). *Republic*, Volume I: Books1-5. Edited and Translated by Christopher Emlyn- Jones, William Preddy. *Loeb Classical Library 237*. Cambridge, MA: Harvard University Press.
Plato. (2001). *Gorgias*, Loeb Classical Library, Plato III, Çev. W. R. M. Lamb, 12. Bs., Londra, Harvard Univ. Press.
Plato. (1994/1999). *Laws*, Loeb Classical Library, Plato X-XI, Harvard University Press, R. G. Bury, London.
Tanzola, (1975) *A Comparative study of The Cardinal Virtues in Cicero's* De Officiis and in Ambrose's De Officiis Ministrorum.

omy, *12*(1), 78–104. https://doi.org/10.1080/09692290500049805

Grossman, G. M., & Helpman, E. (1991). *Innovation and growth in the global economy.* MIT Press.

Kalkan, Y., & Pala, F. (2022). Yüksek Teknoloji Ihracati Belirleyicilerinin Panel Ardl Analizi ile Incelenmesi. *Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. https://doi.org/10.20875/makusobed.1110014

Kavacik, M. (2023). What Did Turkey Do in terms of Export Competitiveness After 2000? *InTraders International Trade Academic Journal*. https://doi.org/10.55065/intraders.1390704

Keller, W. (2004). International Technology Diffusion. *Journal of Economic Literature*, *42*(3), 752–782. https://doi.org/10.1257/0022051042177685

Konak, A. (2018). Yüksek Teknoloji İçeren Ürün İhracatının İhracat Hacmi Ve Ekonomik Büyüme Üzerine Etkisi; Seçilmiş OECD Ülkeleri ve Türkiye Örneği. *Yönetim, Ekonomi, Edebiyat, İslami ve Politik Bilimler Dergisi*. https://doi.org/10.24013/jomelips.489768

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3–42.

Meçik, O., & Afşar, M. (2014). Türkiye Ekonomisinde Yapısal Dönüşümler ve İşgücü Piyasasındaki Gelişmeler. *Optimum Ekonomi ve Yönetim Bilimleri Dergisi*, *1*(2). https://doi.org/10.17541/oeybd.54695

Ng, S., & Perron, P. (2001). LAG Length Selection and the Construction of Unit Root Tests with Good Size and Power. *Econometrica*, *69*(6), 1519–1554. https://doi.org/10.1111/1468-0262.00256

Olcay, T., & Uysal, Y. (2023). Evaluation of The Knowledge Society Effects on Employment In Terms of Turkey. *İzmir İktisat Dergisi*. https://doi.org/10.24988/ije.1291498

Özdemir, F. N., Aksoy, A., & Avcıoğlu, Ü. (2022). Nitelikli işgücü sorunu üzerine çalışma. *Journal of Life Economics*, *9*(3), 159–169. https://doi.org/10.15637/jlecon.9.3.04

Ricardo, D. (1817). *On the principles of political economy and taxation.* John Murray.

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5), S71–S102.

Samaniego, R. M. (2006). Organizational capital, technology adoption and the productivity slowdown. *Journal of Monetary Economics*, *53*(7), 1555–1569. https://doi.org/10.1016/j.jmoneco.2005.06.002

Şeker, A. (2018). Teknoloji Transferinin Teknolojik Gelişim, Üretim ve Yüksek Teknoloji Ürünlerinin Ihracati Üzerindeki Etkisi: Türkiye Örneği. *Business & Management Studies: An International Journal*, *6*(3), 583–603. https://doi.org/10.15295/bmij.v6i3.303

ŞEKER, A. (2019). Teknolojik Gelişme ve Yüksek Teknoloji İhracatının Ekonomik Karmaşıklık Endeksi Üzerindeki Etkisi: Türkiye Örneği. *Yönetim ve Ekonomi: Celal Bayar Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. https://doi.org/10.18657/yonveek.581397

Shin, Y. (1994). A Residual-Based Test of the Null of Cointegration Against the Alternative of No Cointegration. *Econometric Theory*, *10*(1), 91–115. https://doi.org/10.1017/s0266466600008240

Topallı, N. (2015). Doğrudan yabancı yatırımlar, ekonomik büyüme ve yüksek teknoloji ihracatı arasında bir nedensellik ilişkisi. *International Journal of Social Sciences and Education Research*, *1*(1), 277. https://doi.org/10.24289/ijsser.106426

Tsong, C.-C., Lee, C.-F., Tsai, L.-J., & Hu, T.-C. (2015). The Fourier approximation and testing for the null of cointegration. *Empirical Economics*, *51*(3), 1085–1113. https://doi.org/10.1007/s00181-015-1028-6.