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Investigating the effect of productivity shock on structural changes and water transfer potential between Iran and neighboring countries

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EXTENDED ABSTRACT

INTRODUCTION

Due to the water shortage crisis, water resources and optimal consumption of these resources are of great significance. The effects of water scarcity on all countries are a global threat, and the issue of water has been considered regional and international cooperation. "water economy" refers to the set of water resources and consumer sectors that are related through physical capital (equipment, infrastructure) and social capital (institutions, norms and laws) (Zemel & Tsur2018). The transfer and redistribution of water is considered as reallocation of water. According to the United Nations World Water Development Report, three-quarters of jobs around the world depend on water, so water scarcity and lack of access to water may hamper economic growth in the coming years. Water is an important factor in the development of employment opportunities. According to Kuznets' study, Structural change includes a change in direction from agriculture to non-agricultural activities and then from industry to services. One of the most important factors in the movement of inputs between sectors is total factor productivity therefore, in this research, it has been determined to what extent the positive shock of productivity can be effective on the process of structural change. The article answer two questions. First, will there be structural changes in Iran despite the positive productivity shock? And second, is there a potential for water transfer between Iran and neighboring countries with the positive productivity shock?

METHODOLOGY

In this study, calculable general equilibrium models have been used. The data required to simulate the scenarios proposed in this research is taken from the ninth version of GTAP. This version includes the world economy with 140 countries or regions and 57 economic sectors. It is not possible to present all relationships and equations in one article. In addition to the GTAP database, IMPACT data has also been used. The IMPACT model is a hybrid model of water simulation and agricultural partial balance. According to the objectives of the research, the aggregation model has been changed and instead of 140 regions or countries, in one aggregation, Iran and other regions and in other aggregations Iran and neighboring countries (Pakistan, Turkey, Russia, Kazakhstan, UAE, Armenia, Azerbaijan, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia) are considered. 57 parts of the model have been changed to 13 parts and 5 production factors to 8 production factors, these changes are as follows. The sectors include: 1. Agriculture (rice, wheat, oilseeds) 2. Other crops (cereals, fruits, vegetables...) 3. husbandry 4. Forestry 5. Fisheries 6. Coal 7. Oil 8. Gas 9. Industry 10. Petrochemical 11. Electricity 12. Water 13. Services. Factors of production include: water, land, rainfed land, pasture land, skilled labor, unskilled labor, capital and natural resources. One of the most important factors affecting the demand input is productivity, so it has been tried to evaluate the effect of changing this variable in a computable general equilibrium model structure. Productivity shock is considered 0.6% according to the trend of changes in productivity and taking into account Iran's economic conditions, including sanctions and the international crisis such as Corona. Two scenarios are considered in this article. The first scenario of productivity shock for Iran and the second scenario of productivity shock for Iran and neighboring countries.

FINDINGS

First scenario: Productivity shock in Iran

The positive productivity shock 0.6% has no effect on the demand for agriculture and other crops. But on the other three agricultural sectors, the impact on input demand is positive. Oil and gas sectors reduce demand for water with productivity shock. The water demand of the industrial sector is more than all other sub-sectors. That is, with a productivity shock the industrial sector can demand more water, and considering its share of value added, it can be concluded that the transfer of water from agriculture to industry can be justified. The results showed that the productivity shock

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reduces the average growth of skilled and non-skilled laborers in economic sectors, increasing the capital demand on average. Therefore, the defined shock provides a basis for structural changes in Iran.The productivity shock has increased production in most sectors, but notic that the shock in the sectors that have increased water demand has also increased production. But the important point is that the production growth of the industrial sector is much higher than the increase in the demand of this sector for water, which shows the importance of water in the industrial sector. The average comparison of production growth in agriculture and production growth in the industry and services sector is a confirmation of the transfer of water from the agriculture sector to the industry sector.

Second scenario: Productivity shock in Iran and neighboring countries

The effect of the productivity shock in the neighboring countries shows that the structural changes in these countries have a slower process than in Iran.

The results show that even though the economic sectors of bordering countries react to water demand, considering the size of the countries and the contribution of value added of the sectors in the GDP, the justification of water transfer is defensible. This issue can justify the longrun of moving water from neighboring countries to Iran. That is, if there is regional convergence that leads to an increase in productivity, it can provide the potential of transferring water from neighboring countries to Iran. However, to justify economic convergence, it is necessary to use other methods, including gravity models. But we must accept that economic convergence increases productivity. Therefore, the conditions of convergence between Iran and the bordering countries can provide the potential of moving water between these countries

CONCLUSION

In this research, the effect of the positive productivity on structural changes has been investigated. The results showed that the productivity shock reduces the average growth of skilled and non-skilled laborers in economic sectors, increasing the capital demand on average. Therefore, the defined shock provides a basis for structural changes in Iran. Also, the positive shock of productivity can affect the demand for water in the economic sector due to its effect on allocating resources in the economic sector .The results of the 0.6% productivity simulation model for Iran and the rest of the world showed that in the economic sector, structural changes occur through changes in demand

for labor and capital. This process occurs if economic growth is shaped by an unbalanced and unstable pattern. On the other hand, a model with a production efficiency of 0.6 percent has been simulated for Iran and neighboring countries . This simulation showed that due to various effects of this impulse on water demand in different economic sectors, there is the potential for water transfer between Iran and neighboring countries. Therefore, one of the appropriate strategies to achieve the optimal use of water is to investigate the possibility of transferring water between geographical borders. The specific policy suggestions of the research are that, firstly, because the productivity index plays a decisive role in the structural changes, therefore any effective step that can improve productivity has also managed structural changes. Secondly, moving towards water-centered economic convergence between Iran and bordering countries can help in the optimal allocation of water resources.

Reference

Ahangari, A., & Khoramzadeh, A. (2012). Investigation the Effect of Structural Changes on GDP in Iran: with emphasis on product, Export and Labour Productivity. *Quarterly Journal of Quantitative Economics (JQE)*, *9*(1), 71-88. (in persian). doi: 10.22055/jqe.2012.10588

Aizenman, J., Lee, M., & Park, D. (2012). The relationship between structural change and inequality: A conceptual overview with special reference to developing Asia. ADBI Working Paper. No. 396. doi: 10.2139/ssrn.2175383

Antoci, A., Borghesi, S. & Sodini, M. Water Resource Use and Competition in an Evolutionary Model. Water Resour Manage 31, 2523–2543 (2017). doi:org/10.1007/s11269-016-1391-x

Berbel, J., & Gómez-Limón, J. A. (2000). The impact of water-pricing policy in Spain: an analysis of three irrigated areas. Agricultural Water Management. 43(2), 219-238. doi: 10.1016/S0378-3774(99)00056-6

Berrittella, M., Hoekstra, A. Y., Rehdanz, K., Roson, R., & Tol, R. S. (2007). The economic impact of restricted water supply: A computable general equilibrium analysis. Water research, 41(8), 1799-1813. doi:10.1016/j.watres.2007.01.010

Bontemps, C., & Couture, S. (2002). Irrigation water demand for the decision maker. Environment and development economics, 7(4), 643-657.doi: 10.1017/S1355770X02000396

Booker, J. F., Howitt, R. E., Michelsen, A. M., & Young, R. A. (2012). Economics and the modeling of water resources and policies. *Natural Resource Modeling*, 25(1), 168-218. doi:org/10.1111/j.1939-7445.2011.00105.x

Borgomeo, E., Hall, J. W., & Salehin, M. (2017). Avoiding the water-poverty trap: insights from a conceptual human-water dynamical model for coastal Bangladesh. *International Journal of Water Resources Development*, 34(6), 900-922. doi.org/10.1080/07900627.2017.1331842

Burfisher, M.(2011). Introduction to computable general equilibrium models.(Bazazan,f. soleymanimovahed,M, Trans.). (Original work published 1995)

Calzadilla, A., Rehdanz, K., & Tol, R. S. (2011). The GTAP-W model: accounting for water use in agriculture (No. 1745). Kiel Institute for the World Economy. http://hdl.handle.net/10419/54939

Cazcarro, I., Duarte, R., Sánchez Chóliz, J., & Sarasa, C. (2019). Water and production reallocation in the Spanish agri-food system. Economic Systems Research, 32(2), 278-299. doi.org/10.1080/09535314.2019.1693982

Currais Monteiro, H. P. (2005). Water pricing models: a survey. DINAMIA-Research Centre on Socioeconomic Change Working Paper, (2005/45). http://hdl.handle.net/10071/505

Dabi, D. D., & Anderson, W. P. (1999). Development of a commodity-by-industry economic-ecological model of water demand in a rural economy. Journal of Environmental Planning and Management, 42(5), 707-734. doi.org/10.1080/09640569910966

Dachraoui, K., & Harchaoui, T. M. (2004). Water use, shadow prices and the Canadian business sector productivity performance. https://dx.doi.org/10.2139/ssrn.1375627.

Duan, Y., & Liu, G. (2016). Water Resource Pricing Study Based on Water Quality Fuzzy Evaluation: A Case Study of Hefei City. *Computational*

Water, Energy, and Environmental Engineering, 5(4), 99-111. 10.4236/cweee.2016.54010

Easter, K. W. (1987). Inadequate Management and Declining Infrastructure: The Critical Recurring Cost Problem Facing Irrigation in Asia. *Economic Reports*, (6923). doi: 10.22004/ag.econ.6923

Fam, D. M., Turner, A., Latimer, G., Liu, A., Giurco, D., & Starr, P. (2017). Convergence of the waste and water sectors: risks, opportunities and future trends–discussion paper, pp. 1–24. *Institute for Sustainable Futures*, UTS: Sydney, Australia. View/Download from: UTS OPUS

Gohin, A., & Hertel, T. W. (2003). A note on the CES functional form and its use in the GTAP model (No. 2). Center for Global Trade Analysis, Purdue University, 1-14

Goodman, D. J. (2000). More reservoirs or transfers? A computable general equilibrium analysis of projected water shortages in the Arkansas River Basin. *Journal of Agricultural and Resource Economics*, 698-713.

Hosseinzadeh, R., Dadras moghadam, A., & gharanjik, M. (2021). The effect of structural changes on regional economic growth: spatial panel approach. *Quarterly Journal of Quantitative Economics (JQE)*, *18*(1), 51-62. doi: 10.22055/jqe.2020.31664.2175 [In Persian]

Hertel, T., & Liu, J. (2019). Implications of water scarcity for economic growth. In *Economy-wide modeling of water at regional and global scales* (pp. 11-35). Springer, Singapore. doi: 10.1007/978-981-13-6101-2_2

Hosseinzadeh, R., Dadras moghadam, A., & gharanjik, M. (2021). The effect of structural changes on regional economic growth: spatial panel approach. *Quarterly Journal of Quantitative Economics(JQE)*, *18*(1), 51-62. (in persian) .doi: 10.22055/jqe.2020.31664.2175

Koopman, J. F., Kuik, O., Tol, R. S., & Brouwer, R. (2017). The potential of water markets to allocate water between industry, agriculture, and public water utilities as an adaptation mechanism to climate change. Mitigation and adaptation strategies for global change, 22(2), 325-347. 10.1007/s11027-015-9662-z

Liu, X., Chen, X., & Wang, S. (2009). Evaluating and predicting shadow prices of water resources in China and its nine major river basins.

Water resources management, 23(8), 1467-1478.doi: 10.1007/s11269-008-9336-7

Mahinizadeh, M, Yavari, K, Jalaee, S. A, Jafarzadeh, B. (1398). The effect of structural changes on economic welfare in Iran, the approach of calculable general equilibrium models. Financial Economics , 13 (48), 167-190.(in persain) https://doi.org/10.22111/ijbds.2020.5438

Marston, L., & Cai, X. (2016). An overview of water reallocation and the barriers to its implementation. Wiley Interdisciplinary Reviews Water, 3(5), 658-677 doi.org/10.1002/wat2.1159

Martens, A., & Decaluwé, B. (1988). CGE modeling and developing economies: A concise empirical survey of 73 applications to 26 countries. *Journal of Policy Modeling*, *10*(4), 529-568. doi: 10.1016/0161-8938(88)90019-1

Marzano, R., Rougé, C., Garrone, P., Grilli, L., Harou, J. J., & Pulido-Velazquez, M. (2018). Determinants of the price response to residential water tariffs: Meta-analysis and beyond. *Environmental Modelling & Software*, 101, 236-248. doi:org/10.1016/j.envsoft.2017.12.017

Mehrara, M., ahmadzadeh, E. (2010). The Impacts of Total Factor Productivity (TFP) on the Growth of the Iran's Main Economy Sectors. Journal of Economic Research (Tahghighat- E- Eghtesadi), 44(2),(in persain) 20.1001.1.00398969.1388.44.2.10.6

Meinzen-Dick, R. (2006). Water reallocation: Challenges, threats, and solutions for the poor (No. HDOCPA-2006-41). Human Development Report Office (HDRO), United Nations Development Programme (UNDP).

Mesquita, A. M., & Ruiz, R. M. (2013). A financial economic model for urban water pricing in Brazil. Urban water journal, 10(2), 85-96. doi: 10.1080/1573062X.2012.699073

Mohammadi, T., Akbarifard, H. (2008). The Effects of Productivity Shocks on Economic Growth in Iran. Iranian Journal of Economic Research, 11(35), 177-204.(in persian) https://ijer.atu.ac.ir/article_3603.html

Mohayidin, G., Attari, J., Sadeghi, A., & Hussein, M. A. (2009). Review of water pricing theories and related models. African Journal of Agricultural Research, 4(11), 1536-1544.

https://academicjournals.org/journal/AJAR/article-abstract/5DC465232296

Molinos-Senante, M. (2014). Water rate to manage residential water demand with seasonality: peak-load pricing and increasing block rates approach. *Water policy*, 16(5), 930-944. doi:10.2166/wp.2014.180

Monteiro, H., & Roseta-Palma, C. (2011). Pricing for scarcity? An efficiency analysis of increasing block tariffs. *Water Resources Research*, 47(6). doi:10.1029/2010WR009200

Mukherjee, N., 1996. Water and land in South Africa: economywide impacts of reform--a case study for the Olifants river.*Natural Resources Modeling* 2012(25):168–218.dio: 10.22004/ag.econ.97763

Quazi, R. M. (2001). Strategic water resources planning: A case study of Bangladesh. *Water resources management*, 15(3), 165-186. doi:10.1023/A:1013087701408

Randall, A. (1981). Property entitlements and pricing policies for a maturing water economy. *Australian Journal of Agricultural Economics*, 25(3), 195-220. doi:org/10.1111/j.1467-8489.1981.tb00398.x

Reynaud, A. (2003). An econometric estimation of industrial water demand in France. *Environmental and Resource Economics*, 25(2), 213-232. doi:10.1023/A:1023992322236

Roson, R., & Sartori, M. (2015). System-wide implications of changing water availability and agricultural productivity in the Mediterranean economies. *Water Economics and Policy*, 1(01), 1450001. doi:10.1142/S2382624X14500015

Roson, R., & Damania, R. (2016). Simulating the macroeconomic impact of future water scarcity: An assessment of alternative scenarios. *University Ca'Foscari of Venice, Dept. of Economics Research Paper Series No*, 7.

https://www.gtap.agecon.purdue.edu/resources/res_display.asp?recordid=4909

Seung, C. K., Harris, T. R., MacDiarmid, T. R., & Shaw, W. D. (1998). Economic impacts of water reallocation: A CGE analysis for walker

river basin of Nevada and California. *Journal of Regional Analysis and Policy*, 28(1100-2016-89752), 13-34 doi: 10.22004/ag.econ.130523

Tajrishi, M.,& Abrishamchi, A,(2004). Water resources demand management in the country,*1Symposium of National Resources Loss Prevention*.(in persain)

Taheripour, F., Hertel, T. W., & Liu, J. (2013). Introducing water by river basin into the GTAP-BIO model: GTAP-BIO-W (No. 283495). Purdue University, Center for Global Trade Analysis, *Global Trade Analysis Project*. Doi 10.22004/ag.econ.283495

Vahedizade, S., Forouhar, L., Kerachian, R. (2018). Comparative Study of International Water Markets. *Iran-Water Resources Research*, 14(4), 184-197(in persain)

پیوست : (علائم به کار رفته در پژوهش)

Wtr: آب

RfLand: زمین‌های دیم

Lnd: زمین‌های قابل آبیاری

YRj,: نسبت بازدهی آبیاری به بازدهی دیم بخش j در منطقهr

qfei,j,r: تقاضای نهادهi در صنعت j در منطقه r

qlwj,r: ترکیب زمین آبیاری و آب در صنعت j در منطقه r

qkej,r : ترکیب سرمایه و انرژی در صنعت j در منطقه r

qenj,r: ترکیب انرژی(الکتریکی و غیرالکتریکی) در صنعت j در منطقه r

qvaenj,r: ارزش افزوده در صنعت j در منطقه r

qoi,r: تولید صنعت کالای i در منطقهr

qfi,j,r: تقاضا برای کالای i برای استفاده توسط j در منطقهr

qnelj,r: ترکیب کالای غیر الکتریکی در صنعت j منطقهr

qncoalj,r: ترکیب انرژی غیر زغال سنگ در صنعت j منطقهr

pfei,j,r: قیمت بنگاه برای نهاده i در صنعت j

plwj,r: قیمت بنگاه برای ترکیب زمین قابل آبیاری وآب در صنعت j منطقهr

pkej,r: قیمت بنگاه برای ترکیب سرمایه و انرژی در صنعت j منطقهr

penj,r: قیمت انرژی(الکتریکی و غیرالکتریکی) در صنعت j در منطقه r

pfi,j,r: قیمت بنگاه برای کالای i برای استفاده در صنعت j در منطقهr
pvaenj,r: ارزش افزوده قیمت بنگاه در صنعتj در منطقه r
psi,r: قیمت عرضه کالای i در منطقهr
pnelj,r: قیمت کامپوزیت غیر الکتریکی در صنعت j منطقهr
pncoalj,r: قیمت کامپوزیت غیر ذغال سنگ در صنعت j منطقهr
afei,j,r: عامل اصلی افزایش تغییرات فنی توسط صنعت j منطقهr
afi,j,r: تغییرات فنی ایجاد شده از ترکیب نهاده‌های واسطه‌ای
avai,r: افزایش ارزش افزوده تغییر فنی در بخش I منطقهr
aoj,r: خروجی افزایش تغییرات فنی در بخش j منطقهr
ELLWj,r: کشش جایگزینی بین زمین قابل آبیاری و آب درj
ELKEj,r: کشش جانشینی بین سرمایه و ترکیب انرژی در j
ESUBVAj: کشش جانشینی در ارزش افزوده تولید در j
ESUBTj: کشش جانشینی ترکیب نهاده‌های واسطه‌ای در تولید