Discriminating Between the Side Effects of the Firm Behavior: Did We Import COVID-19?

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ABSTRACT

Early COVID-19 presence and related deaths in Turkish cities can be explained by their international trade volume. Trade with China has a higher impact on the pandemic against the total international trade of cities. The ordering between imports, exports and total trade with China varies depending on the stage of the pandemic. As the China were sealed off by many countries, continuing international trade with the country has increasing impact on the case numbers.

Key Words: *COVID-19, City-level Data Analysis, International Trade.*

JEL Classification: *C21, R15, F14, F68*

Firma Davranışlarının Yan Etkilerini Ayrıştırmak: COVID-19'u İthal Ettik Mi?

ÖZ

*Türkiye'deki şehirlerde COVID-19 ve ilişkili ölümlerin erken dönemdeki varlığı uluslararası ticaret hacmi ile açıklanabilmektedir. Çin ile ticaret pandemi üzerinde şehirlerin toplam dış ticaretinden daha yüksek etkiye sahiptir. Çin ile thalat, ihracat ve toplam ticaret ilişkilerinin etkisi arasındaki sıralama pandeminin hangi aşamasında olunduğuna göre değişebilmektedir. Çin ilişkileri*n *pek çok ülke tarafından durdurulduğu dönemde ülke ile devam eden ticaretin vaka sayıları üzerinde etkisi artmaktadır.*

Anahtar Kelimeler: *COVID-19, Şehir Bazlı Veri Analizi, Uluslararası Ticaret*

JEL Sınıflandırması: *C21, R15, F14, F68*

INTRODUCTION

Urban economics is a popular line of microeconomics with a widespread coverage in terms of topics. City-level economic research can be stretched to interdisciplinary areas such as analysis of the pandemic dynamics. The skills of microeconomists regarding the analyses of heterogeneous social units (*e.g.* cities, groups of people) can be an asset for all other disciplines. Comprehensive toolkit of microeconomics can pave the way for different aspects of COVID-19 to be investigated thoroughly. In this viewpoint, it is examined here that whether direct relations with China as the epicenter of the pandemic, or vibrant international ties, provide *early access* to the COVID-19 for Turkish cities during the first wave. Although the primary focus of the contemporary economic literature has been the impact of the COVID-19 to established daily methods like trade and work as Boccaletti et al. (2020) discusses in their editorial note, it is also essential to investigate the opposite direction. This paper, therefore, will be aimed at capturing

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significant effects at any scale of the firms' participation in international business on the early spread of the pandemic.

I. MOTIVATION AND LITERATURE REVIEW

As commonly known, COVID-19 (novel coronavirus, or Sars-Cov-2) had been spread to the world from China. Not all nations were affected simultaneously, nor did they hit similarly. Differing international transmission mechanisms of the pandemic among different nations draw special attention. International relationships can be considered mainly to originate from economic links. Most of the connections between remote parts of the world can be attributed to trade among parties.

The first infected individual in Turkey has been lately diagnosed on March 10, 2020 (Anatolian Agency, 2020). All nations have been responded to the virus by closing their doors to the outer world and tried to block the further spreading internationally. It can be said that the regular linkages have been destroyed by such measures. Therefore, one should need to regard to the early data to associate the international trade with the pandemic. Luckily, the only data at hand is dated to the targeted period for this research.

The early spread of the virus during the Spring of 2020 has been investigated from several economic perspectives. Stojkoski et al. (2020) present a Jointness map regarding socio-economic determinants of the spread in 106 countries worldwide. Similarly, Ehlert (2020) investigates socio-economic determinants of the pandemic in German counties. Valero & Valero-Gil (2020) investigates the determinants of COVID-19 related deaths among low- and high-income countries during the early period of the pandemic. Birenbaum-Carmeli & Chassida (2020) presents findings on the effects of socio-demographic variables on COVID-19 morbidity in Israel. Jošić (2020) presents socio-economic factors that catalyze the spread of the virus in different countries. Varkey et al. (2020) run OLS regressions on socio-economic determinants of the pandemic among 42 Asian countries. Finally, Sha et al. (2020) step into building a dynamic socio-economic data collection in the USA, taking geospatial dimensions into account for future research on the COVID-19 pandemic.

In Turkey, Zeren & Yilanci (2020) provides insight on spatial propagation of the pandemic and Aydogan (2020) shows that the COVID-19 pandemic do not depend on the sizes of Turkish cities. The infected individuals increase in proportion to the city sizes, which means larger cities do not necessarily mean more widespread infection. It encourages the search for other possible explanations for the distribution of COVID-19 pandemic in Turkey.

The literature mainly discusses the effects of the COVID-19 on international trade, but not the other way around. In a recent paper, Krisztin et al. (2020) and Zhang et al. (2020) find that international flight connections constitute a solid way for virus transmission, utilizing aggregated data for countries during the early periods of the pandemic. Casini & Roccetti (2020) investigates the effect of tourism on the resurgence of pandemic in Italy during the Summer of 2020. The majority of the international airline passengers can be thought of flying for business

purposes (Cai et al., 2001). Therefore, participation in the international trade can be an alternative determinant of the propagation of the COVID-19 through personal mobility. It can be tested with regional data covering the early period of the pandemic. In this regard, this paper delivers an important point of view to the practice.

The importance of the timing of the study resides in avoiding the inherent dynamics of the virus. Testing the current model with a later data set would reflect different underlying dynamics such as infectability of the dominant mutation, density of the local economic activity and social interactions. Since the virus has a known origin, an early data set bear the maximum effect of inbound infections to a region. Nevertheless, considering the trade relations only with China can be supported with total international trade in order to capture or compare indirect effects via other countries.

Discriminating between the importing and exporting behavior of firms is a vibrant strand in the literature. There are numerous studies investigating intricate relationship between import and export behavior. Aristei et al. (2013) investigates the relationship between firms' participation in international trade. They find that the probability of participating in importing is not a product of exporting activities. van den Berg et al. (2019) find that firms gain significant growth capabilities over being in both export and import relationships with a particular country, and the exports are also increased with network effects. On the other hand, this paper innovatively tries to investigate the international trade behavior of firms by means of behavioral economics applied to firms as done in Armstrong and Huck (2010) with micro perspective.

Firms are shown to be putting different levels of effort into the export and import activities which might be reflected on the propagation of the virus. While many work on how demanding is the exporting piles up in the literature (for a review, see Paul et al., 2017), the importing is not considered as challenging. However, the line between imports and exports for an import-dependent exporter economy like Turkey is not that straightforward. In macro perspective, there is a two-way relationship between imports and exports in Turkey (Sekmen & Saribas, 2007; Karabulut, 2020). Moreover, the import dependency of the production in Turkey is a more general problem (Mihci & Bolatoglu, 2018). One may regard the importing as a primary occupation for many Turkish firms, whether even involved in production and/or exporting or not. Therefore, the difference in firm behavior collectively matters.

II. DATA

The data on pandemic's spread in Turkey has been limited. There has been a continuous arguing on whether the researchers and the public could get the detailed data on the COVID-19 cases and deaths. One can regard the city-based data released on April 1 and April 3 has been the only available ones during the early phases of the pandemic.

Table 1. City-level COVID-19 Data of Turkey in the First Month of the Pandemic

#	City	Population	April 1 Cases	April 3 Cases	Case Growth	April 3 Deaths	Case per 100k Residents	Death per 100k Residents
1	Istanbul	15,519,267	8,852	12,231	38%	210	78.81	1.35
2	Izmir	4,367,251	853	1,105	30%	27	25.30	0.62
3	Ankara	5,639,076	712	860	21%	11	15.25	0.20
4	Konya	2,232,374	584	601	3%	11	26.92	0.49
5	Kocaeli	1,953,035	410	500	22%	14	25.60	0.72
6	Sakarya	1,029,650	207	337	63%	4	32.73	0.39
7	Isparta	444,914	268	289	8%	2	64.96	0.45
8	Bursa	3,056,120	135	259	92%	8	8.47	0.26
9	Adana	2,237,940	197	241	22%	4	10.77	0.18
10	Zonguldak	596,053	112	197	76%	12	33.05	2.01
11	Samsun	1,348,542	112	167	49%	4	12.38	0.30
12	Kayseri	1,407,409	109	130	19%	4	9.24	0.28
12	**Subtotal**	**39,831,631**	**12,551**	**16,917**	**37%**	**311**	**28.62**	**0.60**
81	**Total**	**83,154,997**	**14,681**	**19,576**	**33%**	**414**	**23.54**	**0.50**

Source: Aydogan (2020), p. 15.

Observing different spread of the virus among cities poses a challenging question. Business ties attributed to the international trade relationships of Turkish cities might serve as an important gateway for the novel coronavirus. This paper aims to assess this proposed transmission mechanism of the pandemic among Turkish cities utilizing the city-based case and death data at hand covering early April, 2020.

Table 2. International Trade Statistics of Turkey, 2019 (bn, $)

2019, $ bn	Turkey
Imports-World	210.343
Exports-World	180.835
Imports-China (% of total)	19.127 (9.1%)
Exports-China (% of total)	2.726 (1.5%)

Source: United Nations Comtrade Database (n.d.)

When it comes to China, international trade links become increasingly vivid considering their imports of $2.1 trillion and exports of $2.5 trillion in total making them the largest international trade participant of the world. As seen from Table 2, China is an important trade partner of Turkey. It can be considered as the largest import source of Turkey. While Turkey regularly imports more in value from Russian Federation in dollar terms, it constitutes mainly fossil fuels. Moreover, Turkey had almost identical value of imports from Germany and China as the second and the third in the international trade account, in 2019. Therefore, wider item coverage and smaller unit value of imports shall make Chinese trade routes of Turkish people more crowded against other nations which export higher-end products to Turkey (United Nations Comtrade Database, n.d.).

III. EFFECT OF INTERNATIONAL TRADE ON THE PRESENCE OF COVID-19 PANDEMIC IN TURKISH CITIES

The severeness of the pandemic in different cities can be examined on different grounds regarding the international trade. First, it has been questioned whether that the total international trade of the Turkish cities with the world has been significant in terms of their early pandemic data. Then, the cities' trade

relationships with China has been reviewed to see if it has any additional explanatory power regarding the pandemic.

Concerning international trade links and the pandemic relationship, OLS regressions has been reported in Table 3 and conducted as:

$$pandemic\_stats_i = \alpha + trade\_stats_i + u_i \quad (1)$$

where *pandemic_stats* refers to the list of three different estimations' independent variables regarding the early COVID-19 presence in Turkey summarized in Table 1, namely Cases by April 1, Cases by April 3 and Deaths by April 3. *i* denotes all 81 cities in Turkey. Dependent variable *pandemic_stats* refer to diagnosed COVID-19 cases in each city by April 1, 2020 (column a) and April 3, 2020 (column b), COVID-19 related deaths by April 3, 2020 (column c) in Table 3[2]. Independent variable *trade_stats* denote monthly imports, exports and total international trade of Turkish cities in January and February, 2020 with China (and with the world in parentheses) in the mentioned order. All data has been regarded as their natural logarithms and α is the constant term.

Each pair of the variables of Equation 1 has been estimated separately using three different dependent variables, two different periods of trade data, and two different trade partners (the exact pairs of dependent and independent variables of all 36 estimations reported in Table 3 are listed in the Appendix). The rationale behind using two different COVID-19 case and two different trade data in close dates is to verify the robustness of the model. In this paper, dependent and independent variables have been crosschecked to assess the robustness. The OLS coefficients retrieved from estimation of sequential cross-section data sets can be expected to be similar without a known structural change in the underlying data generating mechanism. If such divergence between the two estimations were to occur, either the data or the model should be questioned deeply. Opposingly, differentiating cases from death numbers is an important phenomenon regarding the future of the fight against the virus. If the spread of the virus cannot be contained even with the vaccinations, the future yields difficult decisions regarding the accepting a life with Sars-Cov-2, or its variates.

Table 3. Regression Results

	(a)	**(b)**	**(c)**
Jan, 2020	**Cases by Apr-1**	**Cases by Apr-3**	**Deaths by Apr-3**
Imports from China	0.31**	0.32**	0.20**
(Total Imports)	(0.30**)	(0.31**)	(0.23**)
Exports to China	0.27*	0.25*	0.18*
(Total Exports)	(0.27**)	(0.28**)	(0.25**)
Total Trade with China	0.29**	0.30**	0.22**
(Total International Trade)	(0.26**)	(0.27**)	(0.26**)
Feb, 2020			
Imports from China	0.33**	0.34**	0.19*
(Total Imports)	(0.17**)	(0.18**)	(0.11*)
Exports to China	0.35**	0.33**	0.31**
(Total Exports)	(0.26**)	(0.27**)	(0.24**)
Total Trade with China	0.37**	0.37**	0.24**
(Total International Trade)	(0.17**)	(0.18**)	(0.10*)

Note: * denotes 95%, ** denotes 99% statistical significance

[2] It is important to note that those are the only available complete micro data set regarding the pandemic in Turkey.

It can be seen from Table 3 that international trade data have been highly significant regarding the spread of the pandemic and deaths in Turkey. Coefficients related to trade with China reported in the Table 3 turn out to be equal -or lower than the coefficients of international trade with all parties. Although the trade has a lower impact on death relative to the cases, it is still statistically significant. It can be seen that the coefficients are robust to changes in date and types of the pandemic data. It is evident from Table 3 that both the significance and the value of the estimated coefficients using April 1 cases and April 3 cases are very close. Due to the seasonal nature of the monthly trade data, comparison of estimations from January and February the outcome is more valuable due to its robustness. It is seen that the order between the coefficients of China and total international trade do not change much during the two periods.

The estimations reported in Table 3 has a main purpose of sorting the magnitude of different origins of the virus. The coefficients can be interpreted as usual but should be treated with caution[3]. Importing 10% more from China in January is associated with 3.1% increase, and in February it coincided with 3.3% increase in cases on April 1, 2020. On the other hand, while a 10% increase in total imports in January raises the cases on April 1 by 3%, February imports coincide with only 1.7% increase. This diverging nature in additional case numbers is evident throughout Table 3, and confirmed also by April 3 cases and April 3 deaths. Moreover, the effect of trade links with China is evident from the variation of the coefficients. As the lockdown and travel restrictions applied to China and Wuhan by other countries in January, the observed effect of the total international trade diminishes in February (see Taylor, 2021 for a pandemic timeline). It also supports the idea that total international trade captures the indirect effects of China via network effects. It is clear from the estimation results that trade relations with China had been far more important than total international trade of a city in terms of initial spread of the virus regardless of the type of the activity being importing or exporting.

[3] The coefficient of determination (R^2) values reported in the Appendix have been rather low but it does not undermine the value of the observed relations. High R^2 exampled in Krisztin et al. (2020) from linear estimations of this type of remote relationships among directly unrelated variables can be seen irrelevant, if not spurious. A partial explanatory power is, therefore, can be seen harmless and functional for the aim of this paper. Since omitted variables would affect both China and total trade coefficients in the same direction and magnitude, the bias can be disregarded.

Figure 1. Plot of Total Imports in January and February 2020 Against April 1 COVID-19 Cases by the Turkish Cities

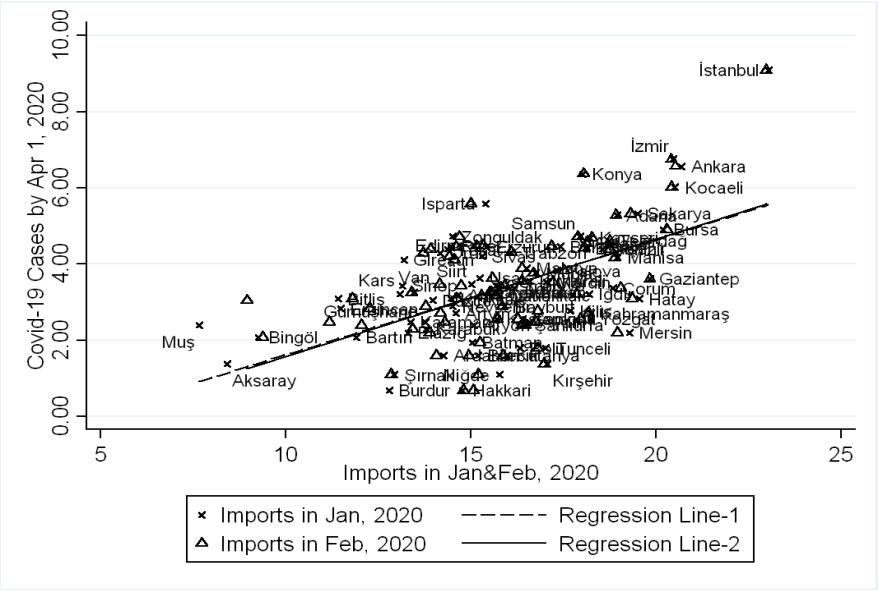
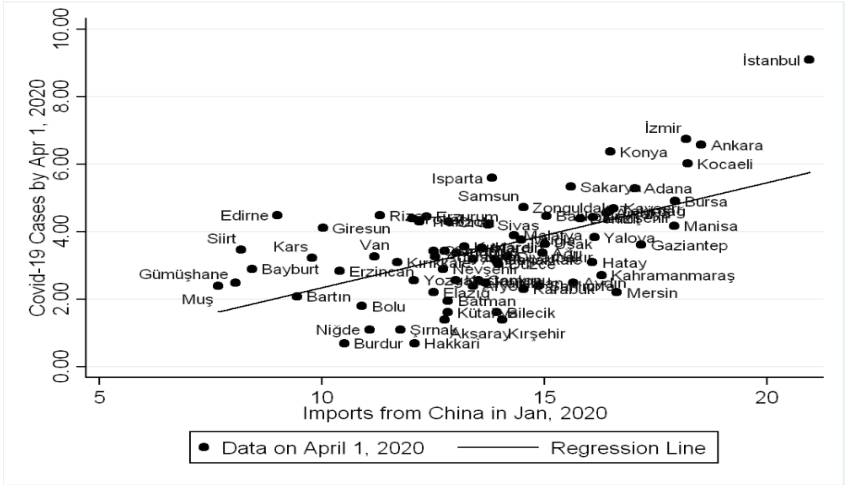


Figure 1 plots total imports during of the cities in Turkey during the early 2020 against COVID-19 cases announced on April 1. The relation between the variables is also visible to the naked-eye. The regressions with January and February data are overlapping which strengthens the robustness of the relationship while the data changes. Being the largest city of Turkey in every aspect by far, Istanbul stood alone at the upper-right corner of the graph as expected. It can be said that the clustering along the regression lines has been satisfying reducing the error.

Figure 2. Plot of Imports from China in January, 2020 Against April 1 COVID-19 Cases by the Turkish Cities



Refining the trade relations of the cities in Turkey, Figure 2 plots imports from China against the COVID-19 cases with the OLS regression line. Despite the fact that the data is more sparsely distributed on the graph, the positive relationship between the variables is evident. The remaining plots of the data and regressions can be found in the Appendix to this paper.

IV. CONCLUSION

Embracing the impact of the COVID-19 urged the nations to understand it's dynamics in order to be prepared for the next global health crisis. The pandemic's adverse effects on the global supply chain have brought the ideas of whether there should be a slowdown in terms of globalization in the future. The vulnerability created by the openness in trade terms might be targeted by the politicians around the world during the current turmoil. A *so-called* trade war, mainly challenging China's strong position as the center of the world production might be on by some industrialized economies. The paper at hand validates such concerns that the economic interconnectedness of nations, and especially with China, increases the effect of similar threats utilizing localized data on the COVID-19 pandemic in Turkey.

The analysis indicates that the early spread of the pandemic in Turkish cities can be associated with their participation in international trade. All regressions have been statistically significant and strikingly positively sloped on the Figures. Trade relationships with China have been statistically significant for the early infection levels and death toll among the cities, while total international trade has less impact as the measures increased globally.

During the preparation of this paper in the early days of pandemic, there were no vaccination available against the virus. The main tool against the spread were lockdowns, whether total or partial. As the availability of the vaccines increase, the new variants seems to bring new threats to the world. Today and the near future likely yields a lifestyle open to recurring infections. It was shown that vaccination largely prevents death from COVID-19 (Bryant, 2021). Despite the first impression of the previous sentence, eliminating death probability makes the remaining losses more important. Therefore, the importance of using a *death by COVID-19* variable in estimations shall become more valuable in the near future.

The timing of the study contributes to the question asked, as it covers the period just before the worldwide closedowns disrupt the daily life. Leverage-versus-squared-residual plots supplied in the Appendix also points to the cities' different circumstances which could be attributed to trade links. Different network effects among cities can be investigated and international travel data in Turkey might be helpful to challenge the findings in the future.

Araştırma ve Yayın Etiği Beyanı

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Çıkar Beyanı

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APPENDIX

Table 4. Legend for the Table 3

Independent Variables	**Panel (a)**	**Panel (b)**	**Panel (c)**
Time Set 1 for Independent Variables: January, 2020	**Dependent Variable 1**	**Dependent Variable 2**	**Dependent Variable 3**
Imports from China *(Total Imports of Turkey)*	Estimation 1 (Estimation 2)	Estimation 3 (Estimation 4)	Estimation 5 (Estimation 6)
Exports to China *(Total Exports of Turkey)*	Estimation 7 (Estimation 8)	Estimation 9 (Estimation 10)	Estimation 11 (Estimation 12)
Total Trade with China *(Total International Trade of Turkey)*	Estimation 13 (Estimation 14)	Estimation 15 (Estimation 16)	Estimation 17 (Estimation 18)
Time Set 2 for Independent Variables: February, 2020			
Imports from China *(Total Imports of Turkey)*	Estimation 19 (Estimation 20)	Estimation 21 (Estimation 22)	Estimation 23 (Estimation 24)
Exports to China *(Total Exports of Turkey)*	Estimation 25 (Estimation 26)	Estimation 27 (Estimation 28)	Estimation 29 (Estimation 30)
Total Trade with China *(Total International Trade of Turkey)*	Estimation 31 (Estimation 32)	Estimation 33 (Estimation 34)	Estimation 35 (Estimation 36)

Table 4. R^2 of the Estimations Reported in Table 3

	(a)	**(b)**	**(c)**
Jan, 2020	**Cases by Apr-1**	**Cases by Apr-3**	**Deaths by Apr-3**
Imports from China *(Total Imports)*	0.32 (0.32)	0.38 (0.38)	0.26 (0.29)
Exports to China *(Total Exports)*	0.14 (0.28)	0.13 (0.33)	0.12 (0.29)
Total Trade with China *(Total International Trade)*	0.26 (0.28)	0.31 (0.33)	0.26 (0.30)
Feb, 2020			
Imports from China *(Total Imports)*	0.30 (0.21)	0.35 (0.26)	0.22 (0.17)
Exports to China *(Total Exports)*	0.20 (0.27)	0.20 (0.32)	0.30 (0.27)
Total Trade with China *(Total International Trade)*	0.29 (0.19)	0.33 (0.25)	0.26 (0.15)

Table 5. Constant Terms of the Estimations Reported in Table 3

	(a)	**(b)**	**(c)**
Jan, 2020	**Cases by Apr-1**	**Cases by Apr-3**	**Deaths by Apr-3**
Imports from China *(Total Imports)*	-0.74 (-1.40)	-0.61 (-1.29)	-1.82* (-2.73*)
Exports to China *(Total Exports)*	0.20 (-1.01)	0.77 (-0.94)	-1.24 (-3.36**)

Total Trade with China *(Total International Trade)*	-0.66 (-1.05)	-0.49 (-0.95)	-2.20* (-3.58**)
Feb, 2020			
Imports from China *(Total Imports)*	-1.05 (0.79)	-0.84 (0.87)	-1.67 (-0.75)
Exports to China *(Total Exports)*	-0.64 (-0.84)	-0.08 (-0.78)	-2.84* (-3.18**)
Total Trade with China *(Total International Trade)*	-1.70 (0.65)	-1.49 (0.69)	-2.51 (-0.73)

Note: * denotes 95%, ** denotes 99% statistical significance

Figure 3. Plot of Total Exports in January and February, 2020 Against April 1 COVID-19 Cases by the Turkish Cities

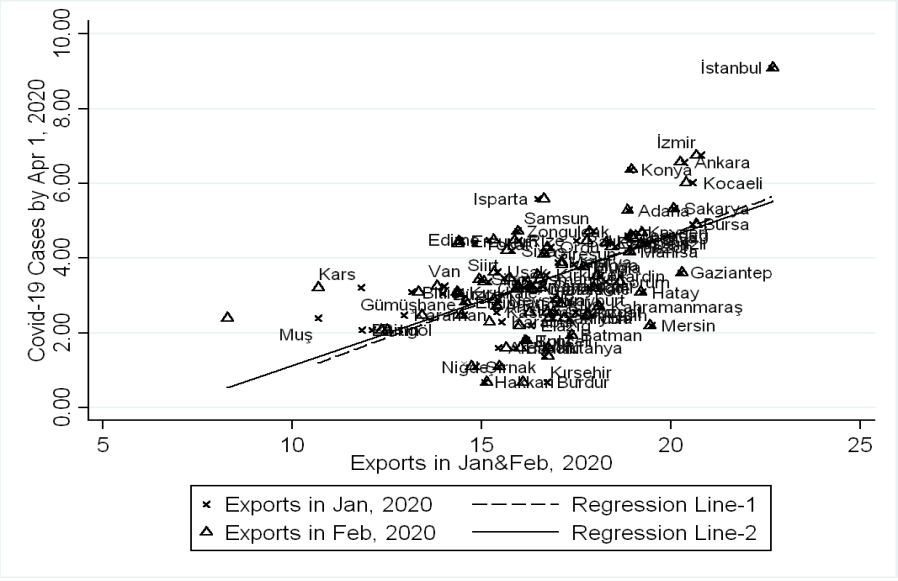

Figure 4. Plot of Total Exports in January and February, 2020 Against April 3 COVID-19 Cases by the Turkish Cities

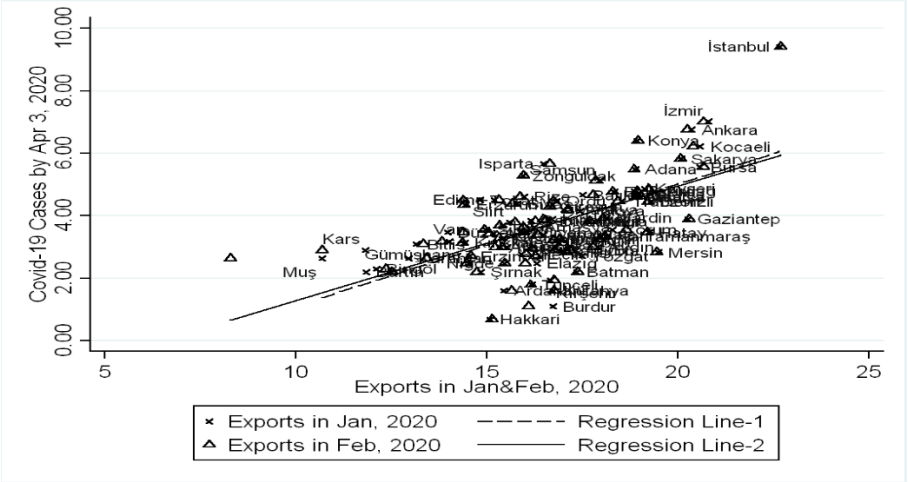

Figure 5. Plot of Total Imports in January and February, 2020 Against April 3 COVID-19 Cases by the Turkish Cities

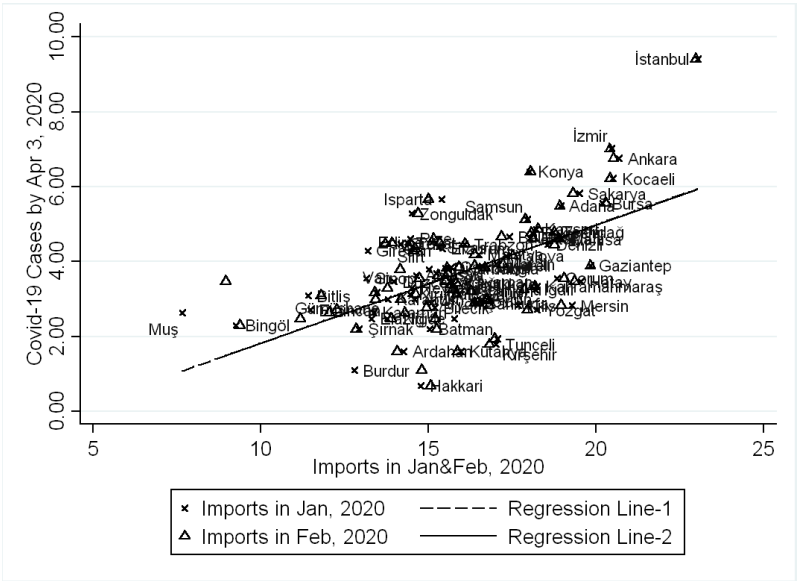

Figure 6. Plot of Total Exports in January and February, 2020 Against April 3 COVID-19 Deaths by the Turkish Cities

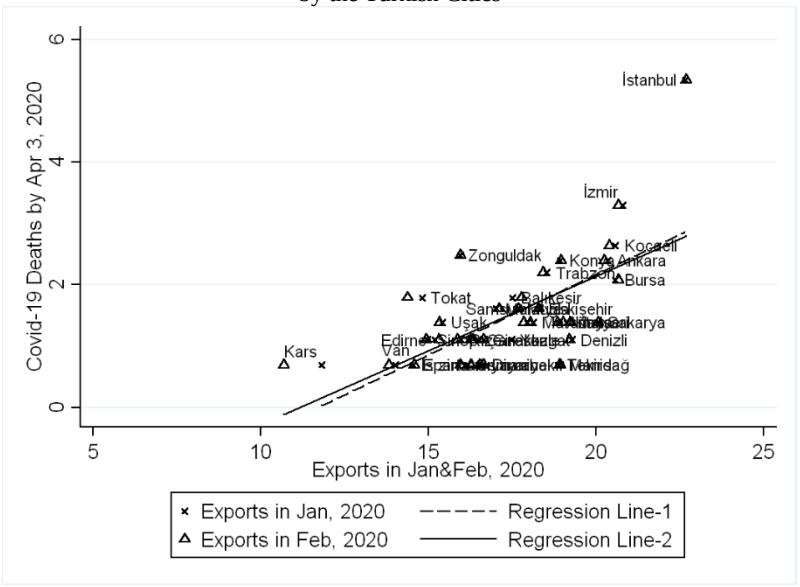

Figure 7. Plot of Total Imports in January and February, 2020 Against April 3 COVID-19 Deaths by the Turkish Cities

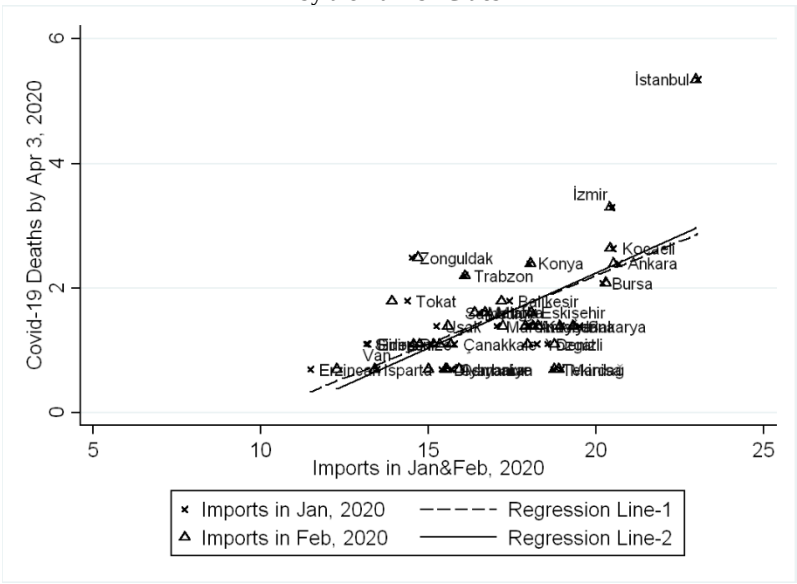

Figure 8. Plot of Total International Trade in January and February, 2020 Against April 3 COVID-19 Deaths by the Turkish Cities

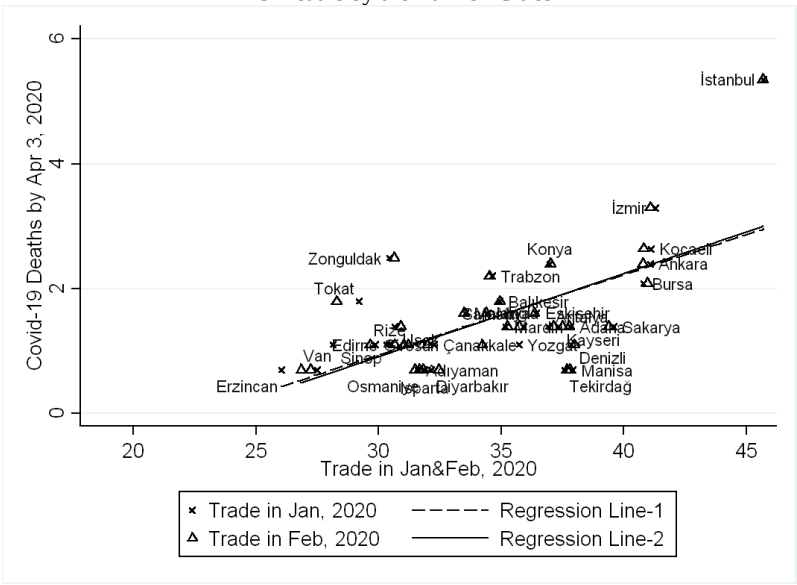

Figure 9. L-R Plot of April 1 Cases Against Imports in January, 2020

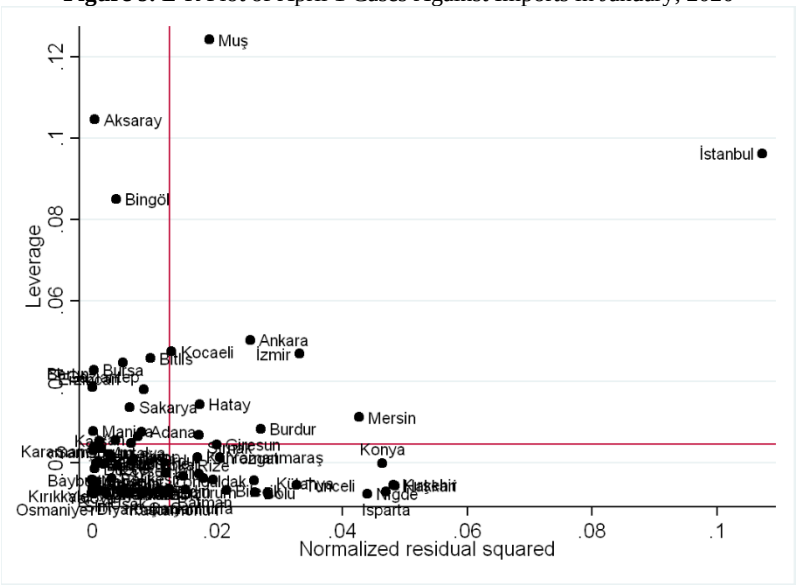

Figure 10. L-R Plot of April 3 Deaths Against Total International Trade in January, 2020

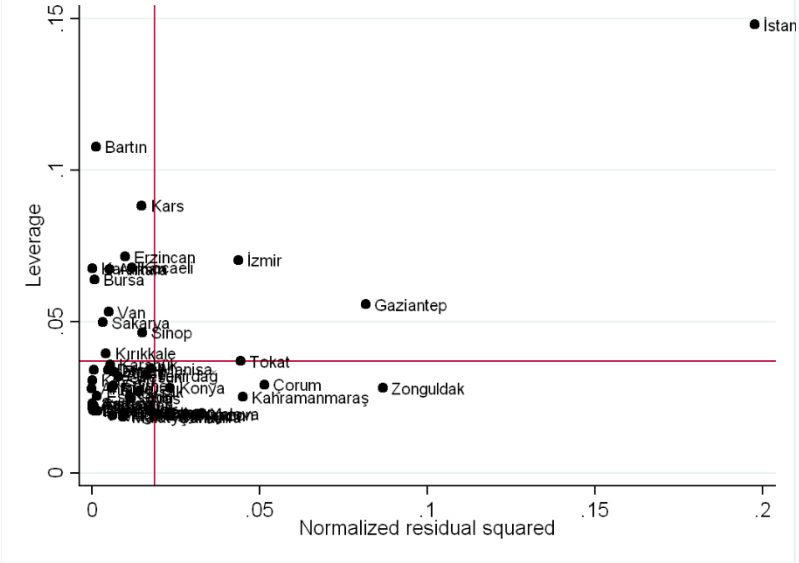

Figure 11. L-R Plot of April 3 Deaths Against Total International Trade in February, 2020

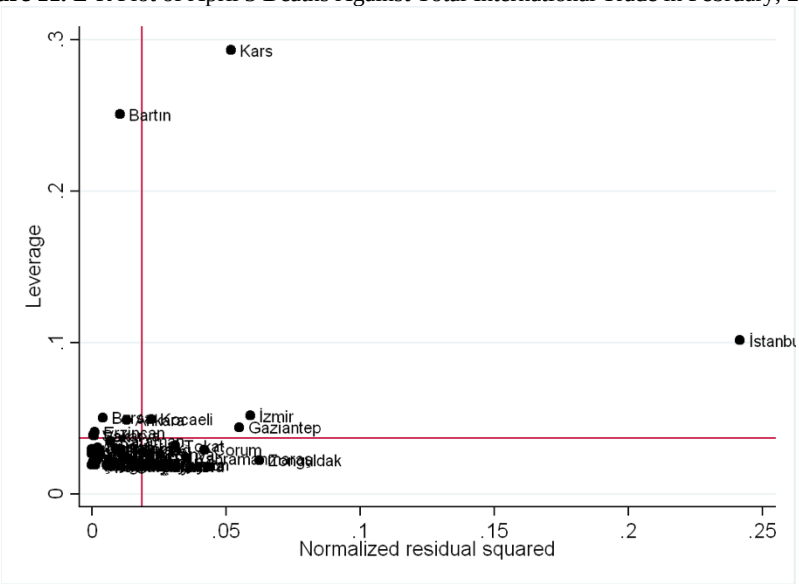

Figure 12. Plot of Total International Trade with China in January, 2020 Against April 1 & 3 COVID-19 Cases by the Turkish Cities

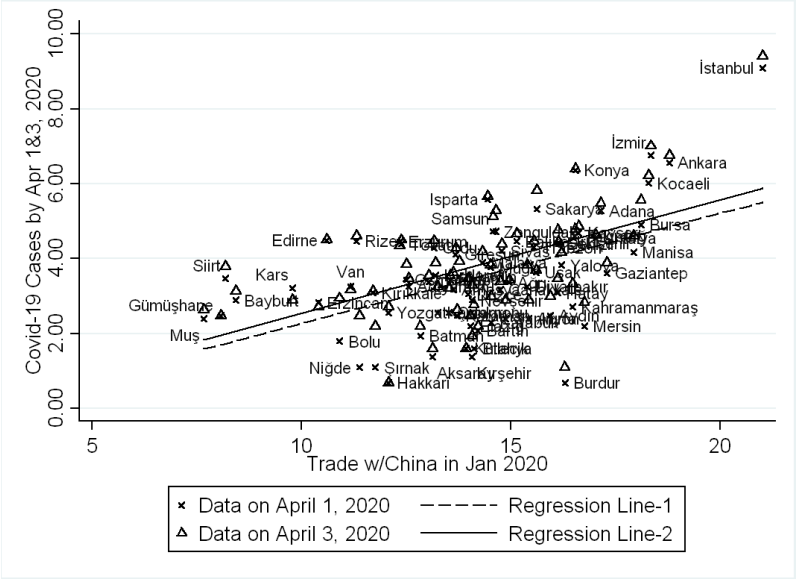

Figure 13. Plot of Total International Trade with China in January, 2020 Against April 3 COVID-19 Deaths by the Turkish Cities

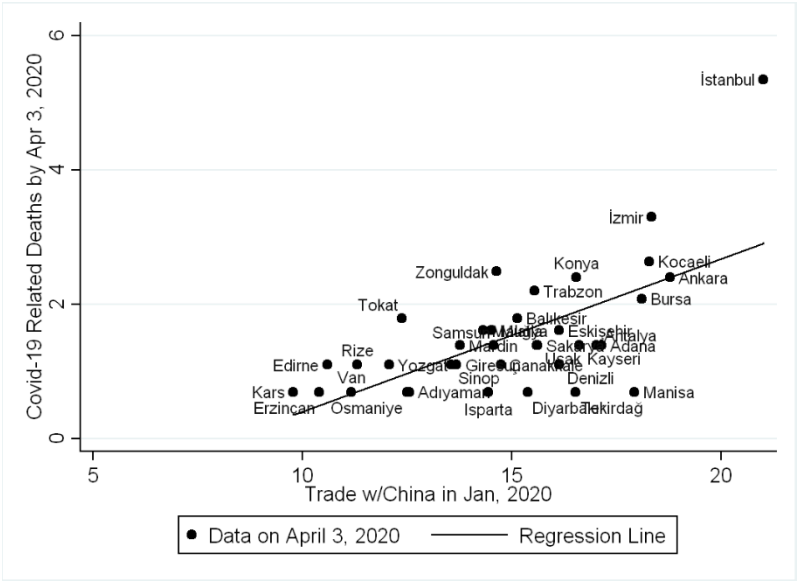

Figure 14. L-R Plot of April 1 Cases Against Total International Trade with China in January, 2020

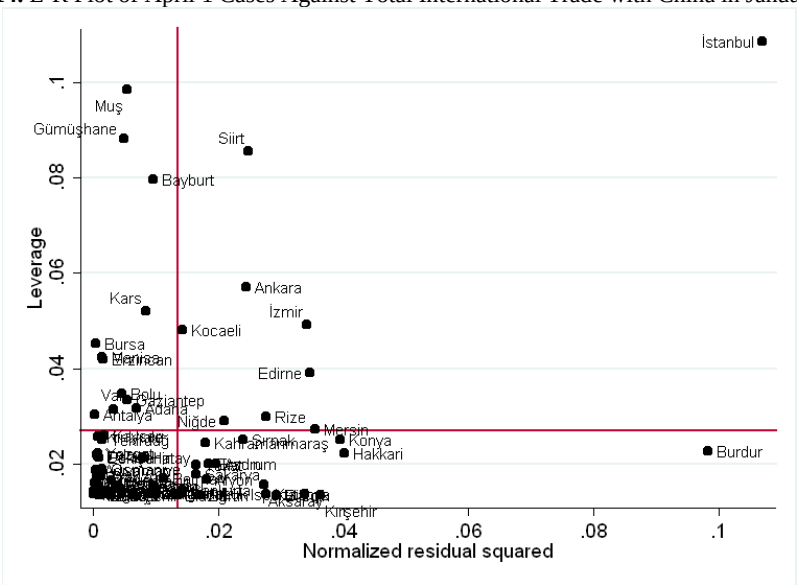

Figure 15. L-R Plot of April 3 Cases Against Total International Trade with China in January, 2020

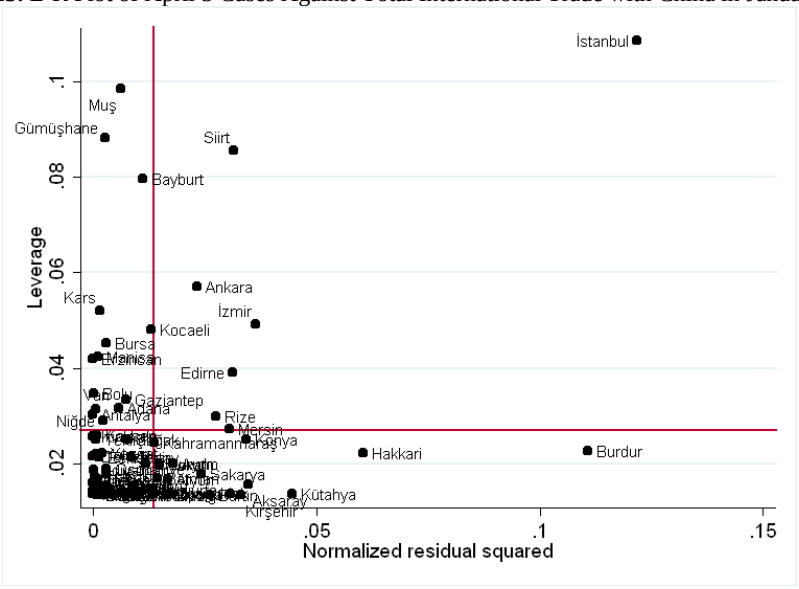

Figure 16. L-R Plot of April 3 Deaths Against Total International Trade with China in January, 2020

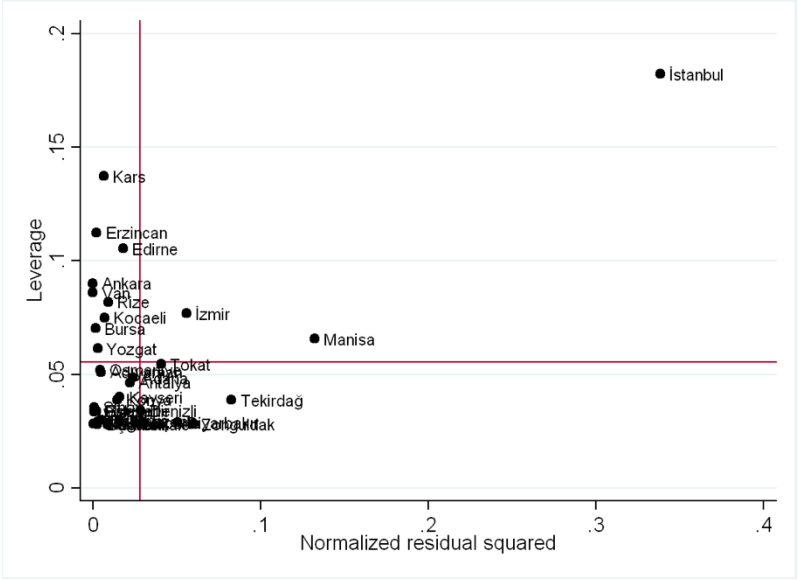

Figure 17. Plot of Imports from China in January, 2020 Against April 3 COVID-19 Cases by the Turkish Cities

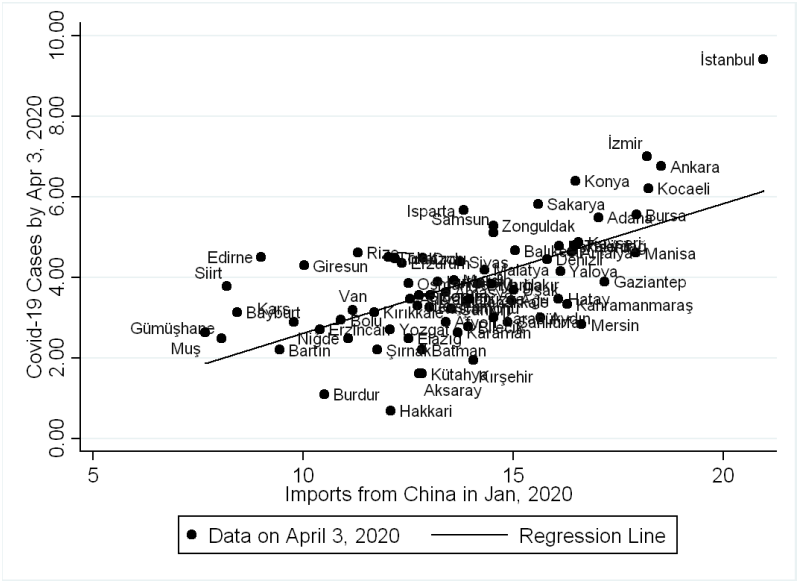

Figure 18. Plot of Imports from China in January, 2020 Against April 3 COVID-19 Deaths by the Turkish Cities