ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

SEARCHING FOR THE IMPACT OF NETWORK CONNECTIVITY ON BORROWING PERFORMANCE: THE CASE OF TURKEY

M.Sc. THESIS

Eğinç Simay ERTÜRK

Department of Urban and Regional Planning

Regional Planning Programme

JULY 2024

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

SEARCHING FOR THE IMPACT OF NETWORK CONNECTIVITY ON BORROWING PERFORMANCE: THE CASE OF TURKEY

M.Sc. THESIS

Eğinç Simay ERTÜRK
(502211802)

Department of Urban and Regional Planning

Regional Planning Programme

Thesis Advisor: Prof. Dr. Ferhan GEZİCİ

JULY 2024

ISTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

AĞ BAĞLANTISININ İKİNCİL ŞEHİRLERİN PERFORMANSINA ETKİSİNİN ARAŞTIRILMASI: TÜRKİYE ÖRNEĞİ

YÜKSEK LİSANS TEZİ

Eğinç Simay ERTÜRK
(502211802)

Şehir ve Bölge Planlama Anabilim Dalı

Bölge Planlama Programı

Tez Danışmanı: Prof. Dr. Ferhan GEZİCİ

TEMMUZ 2024

Eğinç Simay Ertürk, a M.Sc. student of ITU Graduate School student ID 502211802, successfully defended the thesis/dissertation entitled "SEARCHING FOR THE IMPACT OF NETWORK CONNECTIVITY ON BORROWING PERFORMANCE: THE CASE OF TURKEY", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor : **Prof. Dr. Ferhan GEZİCİ**
Istanbul Technical University

Jury Members : **Assoc. Prof. Dr. Kerem Yavuz ARSLANLI**
Istanbul Technical University

Assoc. Prof. Dr. Zeynep Gamze MERT
Gebze Technical University

Date of Submission : 29 May 2024
Date of Defense : 12 July 2024

To my mother and future me,

FOREWORD

In preparing this thesis, I would like to extend my deepest gratitude to my advisor, Prof. Dr. Ferhan Gezici. It has been an incredible privilege to be guided by one of the most distinguished professors in the field. Her extensive knowledge, unparalleled expertise, and unwavering commitment to excellence have profoundly influenced my academic journey. Professor Gezici's mentorship went beyond mere academic guidance; she has been a source of inspiration and a role model, embodying the highest standards of scholarship and dedication. Her insightful feedback, encouragement, and patience have been invaluable throughout this process, and without her support, completing this work would not have been possible.

I am also profoundly grateful to my dear mother, Filiz Ertürk, whose profession as an architect has significantly influenced my development. Her dedication and passion for architecture have been a source of inspiration for me, guiding me toward the field of Urban and Regional Planning. Her unwavering belief in me has been with me every step of the way, and her contributions to my personal and academic growth are immeasurable.

Special thanks to Assoc. Prof. Dr. Zeynep Gamze Mert, a regional planner, whose encouragement played a pivotal role in my decision to pursue a master's degree in Regional Planning. Her participation in my thesis jury and her insightful contributions have enriched this work greatly. I am deeply thankful for her support and mentorship throughout this journey.

I owe thanks to other academics, friends, and family members who provided their assistance and support during this process. Special thanks go to Asst. Prof. Zeynep Elburz and Asst. Prof. Arda Tuncer, who contributed to my work with their insights and help. Additionally, I am grateful to my university and the library staff for providing the resources necessary for my research.

I extend my endless thanks to everyone who contributed to the formation of this thesis, and I hope this work will make a valuable contribution to the field.

July 2024

Eğinç Simay ERTÜRK
(Urban Planner)

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

SEARCHING FOR THE IMPACT OF NETWORK CONNECTIVITY ON BORROWING PERFORMANCE: THE CASE OF TURKEY

SUMMARY

The decline in quality of life in major cities and the rise of secondary cities is a globally observed trend and has significant impacts on economic development and urban planning. It is known that the agglomeration economies and advantages created by major cities stand out in terms of both economic growth and urban performance. In this context, concepts such as agglomeration shadow and borrowed size are important in explaining center-periphery interactions and as important factors affecting the growth and development of peripheral areas. While major metropolises such as Istanbul, Izmir and Ankara in Turkey play a decisive role in the country's economy, surrounding cities are dependent on these centers for economic growth and development. However, concentration of resources and investments in single or specific points may cause agglomeration shadows in surrounding areas. On the other hand, strong network connectivity between metropolitan and secondary cities may enable secondary cities to borrow performance or function; This can facilitate secondary cities' access to resources, investments and knowledge.

This thesis study aims to test the hypothesis that the network connectivity between second-tier and metropolitan cities in Turkey enables second-tier cities to improve their urban performance by borrowing size through these networks. In order to discuss the concepts of "borrowing size" and "borrowing performance", it will be interpreted whether secondary cities exhibit a performance beyond their population size by being included in networks. The term "size" in the context of "borrowed size" is a bit ambiguous because it can relate to both the functions and economic activity found in larger cities as well as the performance level associated with larger cities. With multiple regression analysis, it was determined which parameter affects secondary city performance the most among the variables of network connectivity, size and distance to first-tier cities. Within the scope of the research, two models were prepared, and in the first model, the urbanized area population of the provinces was used for the size parameter, and the distance of the provinces to the closest one of the Istanbul-Ankara-Izmir trio was used for the distance parameter. Network connectivity was measured by provincial data, with the number of domestic and international cargo transported by air and total export parameters. Secondary city performance was measured by the Socio-Economic Development Index of Provinces prepared in 2017. The secondary city performance index, chosen as the dependent variable, includes not only economic activities and functions, but also social, cultural, environmental and infrastructural parameters that measure the liveability of the city.

As seen from studies in the literature, major cities with large populations have an advantage, and secondary cities benefit from their proximity to these metropolitan cities. By examining the impact of independent variables (network connectivity, size and distance) on the dependent variable, urban performance, it will be investigated to what extent network connectivity complements the economies of urbanization and

whether a network-based performance can be borrowed beyond the factors of size and proximity. The contribution of the study is to empirically investigate how network connectivity can function as a catalyst for the development and prosperity of secondary cities in Turkey and whether there is an advantage to being in a network beyond size.

AĞ BAĞLANTISININ İKİNCİL ŞEHİRLERİN PERFORMANSINA ETKİSİNİN ARAŞTIRILMASI: TÜRKİYE ÖRNEĞİ

ÖZET

Büyük şehirlerdeki yaşam kalitesinin düşüşü ve ikincil şehirlerin yükselişi, küresel çapta gözlemlenen bir trenddir ve ekonomik gelişim ile kentsel planlama üzerinde önemli etkileri vardır. Büyük şehirlerin yarattığı yığılma ekonomileri ve avantajlarının gerek ekonomik büyüme gerekse kentsel performans açısından öne çıktığı bilinmektedir. Bu bağlamda, yığılma gölgesi ve ödünç alınan büyüklük gibi kavramlar, merkez-çeper etkileşimlerini açıklamada ve çeper alanların büyüme ve gelişimini etkileyen faktörler olarak önemlidir. Türkiye'de İstanbul, İzmir ve Ankara gibi büyük metropoller, ülke ekonomisinde belirleyici bir rol oynarken, çevre şehirler, ekonomik büyüme ve gelişme için bu merkezlere bağımlıdır. Ancak, kaynakların ve yatırımların tek ya da belirli noktalarda toplanması, çevredeki alanlarda yığılma gölgelerine neden olabilir. Diğer yandan, metropol ve ikincil şehirler arasındaki güçlü ağ bağlantısı, ikincil şehirlerin performans veya fonksiyon ödünç almasını sağlayabilir; bu da ikincil şehirlerin kaynaklara, yatırımlara ve bilgiye erişimini kolaylaştırabilir.

Bu tez çalışması, Türkiye'deki metropol şehirler ile ikincil şehirler arasındaki ağ bağlantısının, ikincil şehirlerin bu ağlar aracılığıyla büyüklük ödünç alarak kentsel performanslarını artırmasına olanak tanıdığı hipotezini test etmeyi amaçlamaktadır. "Büyüklük ödünç alma" ve "performans ödünç alma" kavramlarını tartışmak için, ikincil şehirlerin ağlara dahil edilmesiyle nüfus büyüklüklerinin ötesinde bir performans sergileyip sergilemedikleri yorumlanacaktır. "Ödünç alınan büyüklük" bağlamında "büyüklük" terimi biraz belirsizdir çünkü hem büyük şehirlerde bulunan işlevler ve ekonomik faaliyetlerle ilgili olabilir hem de büyük şehirlerle ilişkilendirilen performans seviyesi ile ilgili olabilir. Çoklu regresyon analizi ile ağ bağlantılılığı, büyüklük ve birincil şehirlere olan yakınlık değişkenleri arasında ikincil şehir performansını en çok etkileyen parametrenin hangisi olduğu belirlenmiştir. Araştırma kapsamında iki model hazırlanmış olup, ilk modelde büyüklük parametresi için illerin kentleşmiş alan nüfusu, yakınlık parametresi için ise illerin İstanbul-Ankara-İzmir üçlüsünden en yakın olanına mesafesi kullanılmıştır. Ağ bağlantılılığı, havayolu ile taşınan iç ve dış yük sayısı ve toplam ihracat parametreleri ile, il bazındaki verilerle ölçülmüştür. İkincil şehir performansı, 2017 yılında hazırlanan İllerin Sosyo-ekonomik Gelişmişlik Endeksi ile ölçülmüştür. Bağımlı değişken olarak seçilen ikincil şehir performansı endeksi, sadece ekonomik faaliyetleri ve işlevleri değil, aynı zamanda şehrin yaşanabilirliğini ölçen, sosyal, kültürel, çevresel ve altyapısal parametreleri de içermektedir.

Literatürdeki çalışmalardan da görüldüğü gibi, büyük nüfusa sahip olan başlıca şehirler avantajlıdır ve ikincil şehirler bu metropol şehirlere yakınlıklarından faydalanmaktadır. Bağımsız değişkenlerin (ağ bağlantılılığı, büyüklük ve yakınlık) bağımlı değişken olan kentsel performans üzerindeki etkisi incelenerek, ağ

bağlantısının kentleşme ekonomilerini ne ölçüde tamamladığı ve ağ tabanlı bir performansın, büyüklük ve yakınlık faktörlerinin ötesinde ödünç alınıp alınamayacağı araştırılmıştır. Çalışmanın katkısı, ağ bağlantısının Türkiye'deki ikincil şehirlerin gelişimi ve refahı için bir katalizör olarak nasıl işlev görebileceğini, büyüklük ve yakınlık gibi faktörlerin ötesinde bir ağda yer almanın bir avantajının olup olmadığını ampirik olarak araştırmasındadır. Özetle, teorik ve kavramsal çerçeve Yeni Ekonomik Coğrafya, Yığılma Ekonomileri ve Ağ Ekonomileri teorilerini yığılma gölgesi ve ödünç alınan boyut kavramlarıyla birleştirir. Türkiye'deki İstanbul, İzmir, Ankara ve çevresindeki ikinci kademe şehirler bağlamında, ağ bağlantısı ile kentsel performans arasındaki ilişki bu teoriler ve kavramlar aracılığıyla açıklanabilir. Ağ bağlantısı, ikinci kademe şehirlerin metropol şehirlerdeki kaynak yoğunlaşmasının neden olduğu kümelenme gölgelerini aşmasını sağlar. İkinci kademe şehirler, metropol merkezlerinde bulunan kaynaklara, yatırımlara ve bilgiye erişerek ekonomik performanslarını artırabilir, yatırım çekebilir, girişimciliği teşvik edebilir, eğitimi iyileştirebilir ve istihdam olanaklarını artırabilir. İkinci kademe şehirlerin ağ bağlantısından ne ölçüde yararlanabileceği ve kentsel performansa ulaşabileceği, ağ altyapılarının, ulaşım düğümlerinin ve telekomünikasyon sistemlerinin gücüne ve ayrıca bağlantıyı ve bölgesel kalkınmayı teşvik etmek için uygulanan politikalara ve stratejilere bağlıdır.

Son yıllarda yapılan çalışmalarda, günümüzün kentsel dinamikleri ile yığılma teorisi arasındaki eksik bağlantıyı, yani yeni ekonomik coğrafyanın açıklamakta yetersiz kaldığı noktaları, bir ağ perspektifiyle tamamlamanın mümkün olduğu ortaya çıkmıştır. Uzmanlaşmış hizmetler ve finans gibi üretici hizmetlerin merkezileşmesinin mekansal organizasyona etkisi ve kentlerin ulusötesi stratejik ağlara dönüşmesiyle dünya ekonomisini yöneten küresel kentlerin ortaya çıkışı, kentlerin omurga bileşenleri olarak hareket ederken nasıl ağ oluşturduğunu tartışmak açısından önemli hale gelmiştir. Küresel düğüm noktaları haline gelen bu 'kurumsal olarak parçalanmış' kentler, büyük, yoğun ve işlevsel olarak çeşitlidir. Bu yoğunluk ve çeşitlilikle kentler stratejik bölgelere dönüşmekte ve büyük pazarlardan, geniş işgücü havuzlarından, gelişmiş altyapıdan ve uzmanlaşmış iş hizmetlerinden yararlanmaktadır. Bu metropol alanlar, Ar-Ge tesislerine, üniversitelere, bilgi üreten kurumlara ev sahipliği yapmakta ve aynı zamanda tüketim merkezleridir. Küresel kentlerde iş olanaklarının ve ikametgahların artması, trafik, rekabet, çevre kirliliği, suç ve toplumsal parçalanma gibi sorunlara yol açmakta ve aslında bu kentlerin çevresinde yer alan daha küçük kentlerin bu sorunları kontrol altında tutmak için daha büyük 'içsel kapasiteye' sahip olduğu fikri bulunmaktadır.

Türkiye'de, İstanbul, İzmir ve Ankara'yı çevreleyen ikinci kademe şehirler önemli nüfus artışı ve ekonomik kalkınma yaşamıştır. Bu şehirler, kendi kentsel performanslarını geliştirmek için metropol merkezlerine yakınlıklarını ve ağ bağlantılarını kullanmaya çalışırlar. Yığılma ekonomileri, ekonomik faaliyetlerin belirli bir coğrafi alanda yoğunlaşmasından kaynaklanan faydaları ifade eder. Bu faydalar arasında bilgi taşmaları, işgücü piyasasının bir araya getirilmesi, uzmanlaşmış girdilere ve hizmetlere erişim ve ölçek ekonomileri bulunur. İstanbul, İzmir ve Ankara örneğinde, Türkiye'deki büyük metropol şehirler olarak statüleri yatırımları, kalifiye işgücünü ve bilgi yoğun endüstrileri çekmektedir. Bu yığılma ekonomileri, çevredeki alanlarda yığılma gölgeleri yaratabilen kaynak ve fırsatların yoğunlaşmasına neden olur. Yeni Ekonomik Coğrafya teorisi, ekonomik faaliyetlerin mekansal dağılımına ve bölgesel kalkınmayı şekillendiren faktörlere ilişkin içgörüler sağlar. Bu teoriye göre, metropol şehirler gibi belirli yerlerdeki ekonomik faaliyetlerin kümelenmesi, ölçek ekonomileri, ulaşım maliyetleri ve kümelenme ekonomileri gibi çeşitli güçler tarafından yönlendirilir. Ekonomik faaliyetlerin belirli bir alanda yoğunlaşmasının, üretkenliği ve inovasyonu artıran olumlu dışsallıklar yarattığını öne sürer. Türkiye bağlamında, İstanbul, İzmir ve Ankara güçlü kümelenme etkileri gösteren metropol şehirleri temsil eder.

Yığılma gölgesi ve ödünç alınan boyutla bağlantılı olabilecek ilgi çekici bir olgu, İstanbul çevresinde ikincil şehirlerin yükselişidir. Bireyler, aileler ve firmalar, İstanbul geliştikçe, daha kalabalık hale geldikçe ve daha maliyetli hale geldikçe alternatifler aramaya başladılar. İstanbul'a yakın olan ikincil şehirler bunun bir sonucu olarak büyüdü ve İstanbul'un ekonomik faaliyetlerinden kar elde edebilirler. Yine de bölgesel planlama ve kalkınma da ikincil şehirlerin yükselişinin bir sonucu olarak engellerle karşılaşmaktadır. Bu şehirler, sürdürülebilir bir şekilde gelişmek ve vatandaşlarına yüksek kaliteli yaşam ortamları sunmak istiyorlarsa, şehirlerin birbirine bağlanmasını, yığılmanın ve ödünç alınan boyutun etkilerini dikkate alan daha büyük bir bölgesel kalkınma stratejisine dahil edilmelidir. Genel olarak, İstanbul'un komşu şehirlerindeki yaşam kalitesi üzerinde hem olumlu hem de olumsuz etkiler vardır ve bu şehirler ile İstanbul arasındaki bağlantıyı çok yönlü ve karmaşık hale getirir. Ağ dışsallıkları, ikinci kademe şehirler ile metropol şehirler arasındaki etkileşimde önemli bir rol oynar. Türkiye'deki ikinci kademe şehirler bağlamında, İstanbul, İzmir ve Ankara ile ağ bağlantısının derecesi, ağ ekonomilerinden yararlanma yeteneklerini belirlemede kritik hale gelir. Güçlü ağ bağlantısı, büyükşehirlerden boyut, kaynak ve bilgi ödünç alınmasını sağlayarak yığılma gölgelerinin etkilerini hafifletebilir. Yığılma gölgeleri, bir metropol şehirdeki kaynak ve yatırımların yoğunlaşması çevredeki alanların gelişimini sınırladığında ortaya çıkar. Öte yandan, ödünç alınan boyut, ikinci kademe şehirlerin ağ bağlantısı aracılığıyla büyükşehirlerden kaynaklara, yatırımlara ve bilgiye erişme yeteneğini ifade eder ve böylece kendi kentsel performanslarını artırır. İkinci kademe şehirler ile İstanbul, İzmir ve Ankara arasındaki ağ bağlantısı, ödünç alınan boyutun kapsamını ve bu ikincil şehirlerin kentsel performansı üzerindeki etkisini belirlemede kritik bir faktör haline gelir.

Türkiye'nin kentsel sistemi bağlamında, yığılma gölgesi ve ödünç alınan büyüklük kavramları, ağ bağlantısının ve ikinci kademe şehirler için çıkarımlarının incelenmesini teşvik eder. Türkiye'de yığılma ekonomileri, ikincil şehirler, ağ ekonomileri ve dışsallıklar üzerine yapılan çalışmalar arasında, "yığınlanma gölgesi ve ödünç alınan büyüklük" kavramlarını tartışan hiçbir çalışma yoktur. Bu nedenle, Türkiye'nin kentsel sistemini bu kavramlarla açıklamaya çalışmak ve kavramları literatüre kazandırmak çalışmanın amaçları arasındadır. Bu çalışma, ikinci kademe ve metropol şehirler arasındaki ağ bağlantısının, bu ağlar aracılığıyla ödünç alınan büyüklükle kentsel performanslarını artırmalarını ne ölçüde sağladığını araştırmayı amaçlamaktadır. Bu araştırma, belirli ağ bağlantı parametrelerini analiz ederek, kentsel performansla en güçlü şekilde ilişkili faktörleri belirlemeyi amaçlamaktadır. Kentsel performans, literatürde yığılma ekonomileri bağlamında çoğunlukla ekonomik göstergelerle tanımlansa da son çalışmalar ekonomik göstergelerin tutarlı bir performans ölçütü olmadığını ortaya koymuştur. GSYİH ekonomik büyüme parametresidir, ancak kalkınmanın tanımı veya eşdeğeri olarak kabul edilebilecek kadar kapsamlı değildir. Bu nedenle çalışmada kullanılan Sosyo-Ekonomik Gelişmişlik Endeksi, ekonomik göstergelerin ötesinde, kentin yaşanabilirliğini ölçen sosyal, kültürel, çevresel ve altyapısal parametreleri de içermektedir.

Bu çalışma, Türkiye'deki ikinci kademe şehirler için ağ kurmanın potansiyel faydalarına ışık tutarak akademi, politika yapıcılar ve şehir plancıları için önemli bir öneme sahiptir. Ağ bağlantısı ve kentsel performans arasındaki ilişkiyi inceleyerek, bu araştırma bölgesel kalkınma ve ağ dışsallıkları hakkındaki mevcut bilgi birikimine katkıda bulunacaktır. Dahası, bulgular politika yapıcılar ve şehir plancılarının ağ bağlantısını etkili bir şekilde kaldıraçlamak, ekonomik büyümeyi, istihdam fırsatlarını, eğitim ilerlemesini ve ikinci kademe şehirlerde endüstri girişimciliğini teşvik etmek için stratejiler formüle etmelerinde yardımcı olacaktır. Dünya çapında ikincil şehirlerin yükselişinin nedenlerini araştıran ve bu yükselişi ağ dışsallıkları ile ilişkilendiren çalışmalar son yıllarda artmış olsa da Türkiye'de hala sınırlı sayıda çalışma bulunmaktadır. Dolayısıyla, kümelenme gölgesi ve ödünç alınmış boyut kavramları bağlamında ikincil kentlerin ağ oluşturma ve kentsel performansını ampirik olarak değerlendiren bu çalışma, kavramların literatüre tanıtılması ve tartışmalara katkı sağlaması açısından önemlidir.

İstanbul-Ankara-İzmir'e yakın olma, büyük nüfusa sahip olma ve ağ ilişkilerinin ikincil şehir performansına etkisini inceleyen ilk modelin analiz sonuçları istatistiksel olarak anlamlı olmasına rağmen, regresyon için anlamlı olan değişkenler yalnızca 1. birinci kademe şehre olan uzaklık ve toplam kargo değişkenleridir. Dolayısıyla ilk modelin kurulumu, bağımlı değişken üzerindeki etki bağlamında boyuttan daha önemli ve anlamlı olan uzaklık ve ağ değişkenlerinin olduğu gerçeğiyle çalışmanın hipotezini desteklemektedir. Aynı bağımsız değişkenlerle ancak bağımlı değişkenin kişi başına düşen GSYİH (log) olduğu model deneyinde yalnızca 1. birinci kademe şehre olan uzaklık ve toplam ihracatın, yani uzaklık ve ağ parametrelerinin istatistiksel olarak anlamlı sonuçlar verdiği görülmüştür. Başka bir deyişle, İstanbul-Ankara-İzmir ile ağ akışlarının olması ve bunlara yakın olmanın, ikincil şehirlerin büyüklüklerinin ötesinde performans ödünç almalarını sağlayabileceği söylenebilir. Öte yandan İstanbul-Ankara-İzmir (1. birinci kademe şehre olan mesafe) ve İstanbul-Ankara-İzmir-Kocaeli-Eskişehir-Bursa-Tekirdağ-Muğla-Antalya (2. birinci kademe şehre olan mesafe) mesafelerinin dahil edildiği 2. modelde, ikincil şehir performans bağımlı değişkeni için istatistiksel olarak anlamlı sonuçlar veren tek değişkenin 1. birinci kademe şehre olan mesafe olduğu görülmüştür. Aynı bağımsız değişkenlerle yapılan kişi başına düşen gsyih (log) bağımlı değişken modelinde, 2. birinci kademe şehre olan mesafe ve toplam ihracat değişkenleri analizde istatistiksel olarak anlamlıdır. Bu bağlamda, ikincil şehirlerin 2. birinci kademe şehirlere olan mesafeleri ve toplam ihracat, yani ağ ilişkileri, kişi başına düşen gsyih için önemlidir. İkincil şehirler arasında birincil şehirlere yakın olmanın avantajı literatürde çok vurgulanmıştır, ancak son çalışmalar, birincil bir şehrin çevresinde yer alan ikincil şehirlerin performansının birbirinden çok farklı olabileceğini göstermiştir. Aynı birincil şehrin çevresinde yer alan iki ikincil şehir ele alındığında, birincil şehre daha yakın olanın diğerine göre daha iyi performans gösterdiği, buna karşın nüfus büyüklüğünün diğerine göre daha az olduğu görülmüştür.

Küresel bir kent sayılabilecek İstanbul, kurduğu ağ ilişkileriyle ülke ekonomisine egemenken, onu izleyen Ankara ve İzmir, oluşturdukları bölgesel ağlar ve bu ağlara gömülü kaynaklarla etraflarındaki küçük kentleri beslemektedir. İstanbul, diğer küresel kentler gibi, güçlü etki alanı ve ülke egemenliği düzeyinde performans gösteren simgeselliği nedeniyle yaşam kalitesi giderek düşen bir kenttir. Ankara ve İzmir, İstanbul kadar olmasa da benzer gündelik yaşam sorunlarıyla karşılaşan kentlerdir. Ekonomik faaliyetlerin, eğitim, sağlık, kültür gibi toplumsal etkinliklerin yoğunlaştığı ve ağırlaştığı bu kentler, taşıt odaklı ulaşım sistemi planlaması nedeniyle kötü çevre koşullarına, yüksek konut kiralarına ve yoğun trafiğe mahkûmdur. Çevre kentlerdeki yaşam kalitesi, en azından çevre sağlığı açısından, görece daha iyi olmakla birlikte, iş, eğitim ve diğer sosyal olanakların yetersizliği nedeniyle daha az tercih edilmektedir. İkincil şehirlerin ağlar üzerinden birincil şehirlerden büyüklük ödünç alması, normalde kendi büyüklükleri kadar sergileyebilecekleri işlev ve performansın ötesine geçmesi, giderek daha çeşitli işlevlere ev sahipliği yapması ve daha yüksek performans sergilemesi, yaşam kalitesini ve dolayısıyla bu şehirlerin yaşamaya tercih edilebilirliğini artırır. Ancak, her ikincil şehrin bu ağlara dahil olmak için yeterli altyapısı ve yerel kapasitesi olmadığından, aralarındaki rekabet de eşitsiz gelişmelere yol açar. Yığılma ekonomileri teorisinin eksikliklerini doldurabilecek planlamadaki politika uygulaması için bir diğer önemli soru, bölgesel ağların rekabetçi ortamının neden olduğu yığılma gölgelerinin nasıl aşılacağı sorusudur. Yığılmanın ve ödünç alınan büyüklüğün faydalarını en üst düzeye çıkarırken rekabetin ve karşılıklı bağımlılığın dezavantajlarını en aza indirmek için, bölgesel planlama literatürü koordineli ve stratejik bir planlamanın gerekli olduğunu ileri sürmektedir. Bu, şehirlerin ve bölgelerin birbirine bağlılığını dikkate alırken iş birliğini ve koordineli planlamayı teşvik eden bölgesel politikaların ve stratejilerin uygulanmasını gerektirebilir. Bölgesel bağlantıyı mümkün kılacak ve ulaşım ve iletişim maliyetlerini düşürecek altyapı ve diğer kamu mallarının sağlanması da bunun önemli bir bileşeni olabilir.

1. INTRODUCTION

Urbanization has become a prevailing global trend, with far-reaching implications for economic development and regional-urban planning. Notably, the decline in quality of life in large cities and the rising interest in second-tier cities have emerged as significant phenomena in this evolving landscape. These transformations have sparked considerable interest in understanding the network externalities that influence the growth and development of surrounding areas. While the effects of primate cities on other cities as the main agglomeration areas of the economy have been discussed in the recent literature, on the other hand, network externalities have gained importance beyond size in the context of their impact on the performance of cities. This study actually aims to make a contribution to the area where these two topics meet and to investigate the extent of the impact area of network connectivity. Among these externalities, the concepts of agglomeration shadow and borrowed size have garnered attention for their impact on the relationship between metropolitan and second-tier cities. The extent to which secondary cities obtain the advantages of agglomerations in the region, depending on their size, and how they exhibit this benefit has emerged as borrowed performance and/or function. While some secondary cities are among those that can benefit from the pool of agglomerations thanks to their size and proximity to big cities, which are considered the engines of the economy, some have been overshadowed by these agglomerations due to the competition between strong rivals or the insufficiency of their own local factors.

1.1 Background of Thesis

Turkey, a country experiencing rapid urbanization, provides an illustrative case study for examining these dynamics. Istanbul, Izmir, and Ankara stand as Turkey's most prominent metropolitan cities, driving the nation's economy and attracting substantial resources and investment. In contrast, the neighboring second-tier cities often rely on the economic vitality of these metropolises for their own growth and development. However, the concentration of resources and investment in a single location can cast agglomeration shadows on the surrounding areas, hindering their autonomous development. Concurrently, network connectivity between the metropolitan and second-tier cities can facilitate borrowed size, enabling smaller cities to access resources, investments, and knowledge they would otherwise lack.

In the context of secondary cities and primary cities, this study is an empirical investigation of the extent to which being included in a strong regional/national network and benefiting from the resources embedded in these networks affects secondary city performance, beyond population size and proximity to primary cities. Therefore, Turkey stands out as an interesting file in terms of investigating the parameters of network connectivity, urbanized area population size, distance to primary cities, which affect secondary city performance in terms of social, economic, cultural development.

1.2 Problem Statement

The juxtaposition of agglomeration shadow and borrowed size in Turkey's urban landscape prompts an exploration of network connectivity and its implications for second-tier cities. Among the studies on agglomeration economies, secondary cities, network economies and externalities in Turkey, there are no studies discussing the concepts of "agglomeration shadow and borrowed size". Therefore, trying to explain Turkey's urban system with these concepts and bringing the concepts to the literature are among the aims of the study. This study seeks to investigate the extent to which network connectivity between second-tier and metropolitan cities enables the former to enhance their urban performance by borrowing size through these networks. By analyzing specific network connectivity parameters, this research aims to identify the factors most strongly associated with urban performance. Although urban performance is mostly defined by economic indicators in the context of agglomeration economies in the literature, recent studies have revealed that economic indicators are not a consistent measure of performance. GDP and GNP are economic growth parameters, but they are not comprehensive enough to be considered as the definition or equivalent of development. Therefore, the Socio-Economic Development Index used in this study includes social, cultural, environmental and infrastructural parameters that measure livability in the city, beyond economic indicators.

1.3 Research Obejctives and Questions

The setup of the research is discussed at the level of investigating the effects of network externalities caused by agglomeration economies on cities, interpreting agglomeration shadow and borrowed size concepts in the context of secondary city performance, and evaluating them through an empirical study. The primary objective of this study is to analyze the network connectivity between second-tier cities and metropolitan cities in Turkey and investigate how this connectivity facilitates second-tier cities' urban performance through borrowed size. To achieve this objective, the following research questions will guide the study:

In the context of metropolitan cities (the most largest trio: İstanbul, Ankara and İzmir) in Turkey and secondary cities in the sphere of influence of these metropolises; How can the concepts of agglomeration shadow, borrowed size, borrowed function and performance be explained?

How does network connectivity between second-tier and metropolitan cities in Turkey influence the urban performance of second-tier cities?

Which specific network connectivity parameters are most strongly associated with urban performance in second-tier cities?

Examining agglomeration shadow, borrowed size, borrowed performance and borrowed function concepts to understand the dynamic between metropolitan and second-tier cities.

Explore the role of network connectivity between second-tier cities and primate cities in Turkey.

Investigate how network connectivity facilitates borrowed size, enabling second-tier cities to enhance their urban performance.

Identify the specific network connectivity parameters that exhibit the strongest association with urban performance.

1.4 Significance of the Study

This study holds substantial significance for academia, policymakers, and urban planners by shedding light on the potential benefits of networking for second-tier cities in Turkey. By examining the relationship between netowork connectivity and urban performance, this research will contribute to the existing body of knowledge on regional development and network externalities. Furthermore, the findings will be helpful for policymakers and urban planners in formulating strategies to effectively leverage network connectivity, fostering economic growth, employment opportunities, educational advancement, and industry entrepreneurship in second-tier cities. The study's contribution lies in its empirical investigation of how network connectivity can serve as a catalyst for the development and prosperity of second-tier cities in Turkey. Although studies investigating the reasons for the rise of secondary cities around the world and associating this rise with network externalities (OECD, 2019) have increased in recent years, there are still a limited number of studies in Turkey. Therefore, this study, which empirically evaluates the networking and urban performance of secondary cities in the context of the agglomeration shadow and borrowed size concepts, is important in terms of introducing the concepts to the literature and contributing to the discussions.

2. LITERATURE REVIEW

This chapter provides a comprehensive review of the relevant literature on urbanization trends, agglomeration shadow, borrowed size, network connectivity, and previous studies on network connectivity in Turkey. In order to associate the concepts of agglomeration shadow and borrowed size with the sample area and the study, it is necessary to understand the theories that base these concepts such as agglomeration economies, the new economic geography, and even network economies. The literature review aims to establish a theoretical foundation for understanding the dynamics between second-tier cities and primate cities, particularly in the context of network connectivity and its impact on urban performance.

The theoretical and conceptual framework for understanding the interaction between second-tier cities and metropolitan cities in Turkey revolves around several key theories and concepts. These include New Economic Geography, Agglomeration Economies, Network Economies, the rise of second-tier cities, and network externalities such as agglomeration shadow and borrowed size. By synthesizing these theories and concepts, we can establish the relationships that explain the context of the performance of secondary cities in Turkey, particularly in relation to the network connectivity and urban performance of Istanbul, Izmir, and Ankara and their surrounding areas (Figure 2.1).

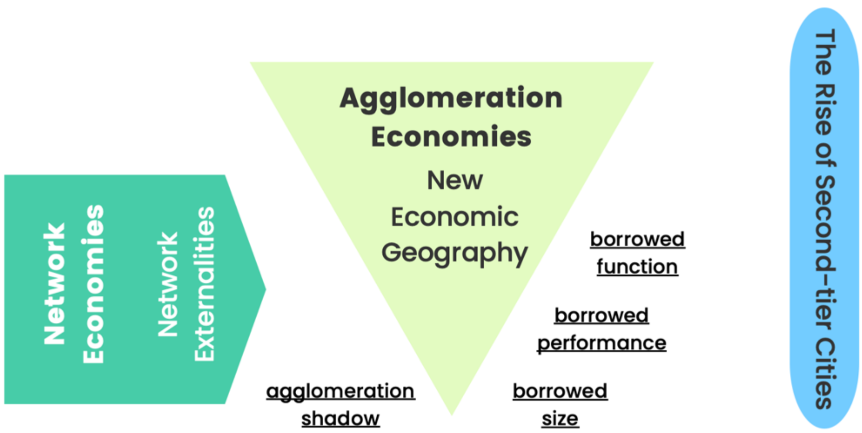

Figure 2.1 : Theoretical and conceptual framework.

2.1 The Rise of Second-Tier Cities

Urbanization is a global phenomenon characterized by the concentration of population and economic activities in urban areas. In recent years, a shift has been observed from the dominance of large cities to the emergence of second-tier cities. This shift challenges traditional notions of urban hierarchy and highlights the increasing importance of these secondary cities as engines of economic growth and centers of innovation. Scholars have examined the factors driving the rise of second-tier cities, including the potential for improved quality of life, lower costs, and increased opportunities for entrepreneurship and innovation. The fact that the country's economies are based on large cities, the increasing population moving to these cities, and the problems of interregional imbalances in the urban system have increased the interest in secondary cities. The rise of smaller or secondary cities in the country's economy forms the basis of such interest. While large cities carry the disadvantages of agglomeration as well as its advantages, the question of whether secondary cities can carry these advantages without the disadvantages is another interesting issue.

In several of the developed European countries over the past ten years, the trend of increasing population and economic growth in the major cities relative to the rest of the nation has slowed or even reversed. This tendency could be explained by Europe's distinctively polycentric urban structure, which includes a high proportion of small- and medium-sized cities, better access to services outside of major cities, and unfavorable externalities in major cities. In contrast to the megacity approach, this tendency, according to Dijkstra et al. (2013), reveals alternate growth trajectories that could be just as effective. While core city areas—and particularly capital city regions—play a crucial role in the European economy, so do many other regions. Their study's key point is not that growth restrictions have no impact, but rather that population and expansion of the economy in Europe, particularly in northwestern Europe, do not always follow a linear pattern dictated by large city logic. The strong trends away from metro and urban regions and the diversity of growth trends within metro regions demonstrate that size is not a good predictor of growth. It also implies that aggregate gains driven by a few large urban regions need to be weighed against potential aggregate gains driven by many smaller second-tier regions with growth potential.

In a similar research, Dijkstra (2013) hypothesized that investing in a portfolio of cities rather than the biggest city initially could promote growth more. The productivity differences between the capital cities and the rest of the nation are significant and widening in the less developed EU Member States. The productivity gaps are substantially less in the more developed Member States, which implies that in the medium term, development in second-tier cities in less developed Member States will probably outstrip growth in capital.

Camagni and Capello (2014) discussed the theoretical justifications for the growth potentials of second-rank cities. They reviewed earlier hypotheses and asserted that the most intriguing theory is the one that connects the expansion of second-rank cities to agglomeration economies. It was determined that second-rank cities played a crucial part in the new industrial structure as independent hubs of economic activity, forming separate labor markets, where a specialized group of trade-oriented sectors established employment and population growth trajectories. While second-rank cities have been viewed as having increasing returns while being far from the ideal city size predicted by urban economic theory, the collapse of large cities has been linked to the appearance of declining returns to urban size. Agglomeration economics have once again been cited as the primary justification for urban performance, seen as a structural dynamics law that can account for both cities' success and failure.

In another study in this context, Camagni et al. (2014) discussed the contribution of second-rank cities to national development. The simplistic interpretation that urban economic performance only depends on the utilization of agglomeration economies and that these agglomeration economies alone depend on the size of cities alone should be abandoned, they claimed, in favor of a more complicated viewpoint. It has become clear that European first-rank cities have not always been the driving force behind national economic success, and even then, there hasn't been a discernible difference between first- and second-rank cities in terms of explaining national growth. Second-rank cities have done better than first-rank cities, and they are now the key engines for the growth of the national economy. They suggested that a more complex perspective is required to comprehend the role of agglomeration economies in urban economic performance, which depends on the capacity to draw in or develop new and higher order functions, boost internal efficiency, and achieve scale economies through cooperation networks with other cities.

Cardoso (2016) investigated the characteristics that separate secondary urban regions in Europe from primary urban areas. He concluded that these areas may benefit from this level of integration and looked into whether any features would make it easier for them to accomplish this. The results show that the distinctive functional, spatial, socioeconomic, and institutional characteristics of second-tier urban regions in Europe, which set them apart from main urban areas, provide second-tier urban areas a better capacity for regional integration. With regard to second-tier urban districts in particular, the idea of metropolitanization offers an interpretive lens through which to view the integration of urban districts.

Regarding the existence of urban functions and how they are distributed throughout their urban districts, Cardoso and Meijers (2016) contrasted Europe's second-tier and first-tier cities. The results show that first-tier cities have an extra amount of urban functionality known as the "first city bonus" that cannot be accounted for by network resilience or size. In the absence of a dominant capital, urban functions are better able to support second-tier cities. Therefore, a distinctive research and policy approach is needed for second-tier cities, where city-regional integration is a key regional development strategy.

For second-tier cities in Europe, Cardoso and Meijers (2017) argued about the advantages of metropolitan integration. They investigated the approaches that might most effectively handle the benefits and challenges of a metropolitan integration process. Their research suggests that metropolitan integration can help second-tier cities capitalize on the advantages of agglomeration, employ shared resources effectively, and gain political-institutional clout. Metropolitan integration might help in overcoming the difficulties that many second-tier cities have when compared to first-tier cities in these regions. For many second-tier cities, the formation of metropolitan regions is a potential option. Planning and governance techniques can help to manage the benefits and challenges of a metropolitan integration process.

Gong and Zhong (2021) examined the relationship between borrowing size and the economic growth of small and medium-sized Chinese cities by looking at data from

2004 to 2013. Their study's findings point to an important finding: in the context of small and medium-sized cities, borrowing size has a positive impact on economic development. It's interesting to note that in larger cities, this effect is not statistically significant. Meijers and Cardoso (2021) investigated how cities in multicentric urban zones are becoming more linked and dynamic. They examined the reasons why certain cities could gain from metropolitan integration while others would experience the negative effects of agglomeration using the theoretical frameworks of "borrowed size" and "agglomeration shadows." The authors find crucial elements linked to places either in the "agglomeration shadow" or in positions with "borrowing size" by looking at cities within the framework of Randstad Holland (120 municipalities). Disparities in the development patterns during the process of metropolitan integration were shown by the research findings.

2.2 Agglomeration Economies | New Economic Geography

The theories of New Economic Geography and Agglomeration Economies provide a framework for understanding the concentration of economic activities in metropolitan cities and the positive externalities generated by such agglomerations. As a result, these metropolitan cities become hubs of economic activity, leading to agglomeration shadows in their surrounding areas. However, network connectivity acts as a mechanism to mitigate these shadows by facilitating the flow of resources, information, and knowledge between metropolitan and second-tier cities.

According to Krugman's (1991) findings, the concentration of economic mass inside a metropolis, rather than the location of resources, largely determines where a metropolis is located. The metropolis is self-justifying due to the concentration of economic mass, which makes it an optimal place for manufacturing companies. This method explains how historical accidents and self-fulfilling expectations shape the metropolitan location. Its impact of distance on production is usually neglected by economic theory. Krugman (1992) presents a synthesis of concepts found in the economic geography literature and outlines new approaches for conducting economic geography research. In this research, he contends that an essential problem within and between countries is about the location of production in space.

Ciccone and Hall (1993) examined the link between employment density and productivity. They offered two models that demonstrate how employment density and productivity are related. The results of studies using data from the US show that agglomeration effects in denser areas outweigh congestion costs. Since the middle of the 19th century, transportation and commuting costs have decreased, but major and enduring regional disparities still remain. The emergence of cities and commercial areas can be explained by the interaction of agglomeration and dispersion forces. The economics of agglomeration considers a number of critical variables, including the mobility of goods and production factors, housing and commuting costs, business productivity, and consumer welfare. Fujita and Thisse (1996) discussed the challenges of the economics of agglomeration and how they can be met. Their research explains how factors such as increasing returns, increasing costs of transportation and commuting, and worker and firm mobility all contribute to the concentration of people and economic activity.

From the standpoint of evolutionary economic geography, Fujita and Mori (1996) suggested an evolutionary model in which agglomeration economies and the hub effect of transport nodes interact to generate metropolitan areas. The concept explains the irreversibility of spatial economic development, such as port cities' continued success long after their initial benefit of having access to water had become insignificant. It is proposed that temporary protection of companies in the peripheral area by deteriorating the transport link with the core for a brief period of time may be beneficial in order to decentralize industry from the core region to a periphery region. Contrarily, the study by Glaeser and Kohlhase (2004) found that the development of natural urban centers was no longer influenced by fixed infrastructure transportation (train and water). Transportation costs for manufactured goods have diminished by approximately 90% during the past century. The consequences of a society where moving people is pricey while moving commodities is practically free have empirical proof. Nevertheless, the principle of irreversibility of the evolutionist economic perspective and the continued success of port cities cannot be ignored.

Massive economic agglomerations exist at various scales of space, and Fujita, Krugman, and Venables (2000) offer a solid and cogent explanation for why this is the case in their study. One of the most fascinating topics within contemporary economics is the new economic geography. Numerous difficulties in urban, regional, and global economics may be addressed using a common strategy that highlights the three-way interplay between increasing returns, transportation costs, and the mobility of productive factors.

A comprehensive examination of the many economic causes for the clustering of companies and households was offered by Fujita and Thisse (2002). The research primarily focuses on cities, but it also investigates the emergence of other agglomerations, such as commercial districts inside cities, industrial clusters at the regional level, and the existence of regional imbalance. A trade-off between increasing returns and higher costs for transportation leads to the formation of cities and other agglomerations. Economic factors like the concentration of companies and households cause cities and other agglomerations to emerge. The formation of agglomerations can be used to explain regional imbalances. Rosenthal and Strange (2004) discussed the empirical literature on the characteristics and causes of urban increasing returns. The industrial, geographic, and temporal scope of agglomeration economies are the three dimensions across which the consequences of agglomeration are most strongly highlighted in the study. Findings show that while agglomeration economies span industrial, geographic, and temporal dimensions, they attenuate with distance. Labor market pooling, input sharing, and knowledge spillovers are some of the micro-foundations of external economies of scale. Agglomeration is further facilitated by natural advantages, influences of the home market, opportunities for consumption, and rent-seeking.

The presence of agglomeration economies, which arise when productivity increases with density, is universally acknowledged by urban economists. Manufacturing companies used to cluster to lower the cost of transporting goods, but this factor is no longer essential to the prosperity of cities. Glaeser and Gottlieb (2009) discussed agglomeration economies and spatial equilibrium in the United States. They found that the influence that density may have on accelerating the flow of ideas is far more important in contemporary cities. Tripathi (2013) examined the factors that influence urban agglomeration and how they contribute to India's urban economic growth. He discovered that agglomeration economies are both policy-induced and market-determined, and that agglomeration has a significant beneficial impact on urban economic growth.

In his early studies, Krugman (1998) examined the new economic geography, a field of study that has developed since 1990. The 'new trade' and 'new growth' theories both employ technical strategies that the new economic geography incorporates as part of its modeling approach. This approach to modeling enables the creation of completely general equilibrium models that infer aggregate behavior from individual maximizing. The new economic geography makes suggestions on how historical accidents may shape economic geography and how gradual shifts to the underlying factors might result in abrupt changes to the spatial organization. In the perspective of new economic geography, Ottaviano and Puga (1998) addressed the implications of integration on location. They discovered companies spread out over different areas as a result of high trade expenses. Integration causes businesses and workers to cluster together and reduces the incentives for self-sufficiency. Businesses may relocate to places with reduced costs for goods produced locally and immobile local factors due to low transportation costs. The main finding was that agglomeration increases the cost of locally produced products and immobile aspects.

The new economic geography theory's main ideas involve increasing returns to scale and rising transportation costs. Schmutzler (1999) asserts that in order to give an integrated approach to interregional and international commerce, the new economic geography literature incorporates ideas from conventional regional science and modern trade theory.

Neary (2001) reviewed The Spatial Economy by Fujita, Krugman, and Venables. He claimed that the framework implemented by the new economic geography to simulate the trade-off between dispersion and agglomeration uses the fundamental components of mainstream economics. The method provides a choice-theoretic foundation for the concept of "propensity to agglomerate." Head and Mayer (2004) explored empirical methods for assessing the significance of agglomeration and trade models. The interplay between transportation expenses and firm-level scale economies is highlighted by NEG theory as a cause of agglomeration. After reviewing the available literature, they provided an overall evaluation of the empirical evidence supporting NEG.

Fujita and Krugman (2004) argued over the new economic geography's past, present, and future. They outlined certain fundamental models and defined the new economic geography. Following that, a study of NEG's different important components is given, and the essay concludes with a discussion of the field's upcoming problems and difficulties. The study of the geographic distribution of economic activity is known as the new economic geography. It is based on models that describe where economic activity occurs and how spatial relationships affect that activity's location. They came to the conclusion that the consequences of globalization, regional inequities, and the function of public policy are important features of the new economic geography. NEG models consider the internal organization and industrial diversity of urban agglomerations, as well as land markets. Gaigne and Thisse (2021) reviewed the latest developments in the new economic geography literature that concentrate on the behaviors and interactions of households and companies located in urban agglomerations. The behaviors and interactions of the companies and households that make up each region's economy contribute to the variations in its economic performance. The dynamics of urban agglomerations and the part played by land markets in determining their economic performance are both usefully illuminated by NEG models.

2.3 Network Economies

Network economies emphasize the role of networks and connectivity in driving economic development. A well-developed network infrastructure, including transportation networks and telecommunication systems, and institutional linkages facilitate the exchange of goods, services, and knowledge, enabling cities to access resources and markets. Scholars have emphasized the positive relationship between network connectivity and urban performance, highlighting its potential to foster economic growth, innovation, and social development. Effective network connectivity enables second-tier cities to tap into the economic opportunities offered by metropolitan cities, access markets, attract investments, and leverage knowledge spillovers. The global economy has led to the emergence of network cities, which are defined by collaboration between two or more cities to attain scope economies. Knowledge-based pursuits like research, education, and the arts are prioritized in creative network cities. Batten (1995) asserts that network cities may in the future transcend national boundaries by utilizing global human resources.

An emerging economic growth model since the 1990s is network behavior. The idea of the city network paradigm, according to Capello (2000), asserts that cities take use of scale economies in complementary interactions and synergies in cooperative activities. Findings indicate that only those economic players who are partners in the economic and spatial network may actually get network advantage, which is a club good. In this research, network externalities resulting from network behavior in territorial systems are quantified. Globalization has brought about a situation where services and urban areas are interconnected on a worldwide scale. These cities are linked through intricate networks of relationships between them. In a study by Taylor and Derudder (2003), they explored the concept of global city networks and the way cities are positioned within the context of globalization. Their argument centered on the idea that cities are gaining increasing significance in the global economy and in society as a whole.

In his article, Boix (2003) proposes the idea of "city networks theory" and clarifies the interactions between these networks, "external economies," and their effects on "economic growth." According to Boix (2003), "Cities do not exist in isolation; they are interconnected entities." In addition to the more well-known agglomeration economies, city networks also give rise to network economies, which have a significant impact on urban growth. He gives specific examples of city networks, including Piedmont and Lombardy, Randstad, Kansai, and France, to show how this idea might be applied in practice. An outstanding example of how city networks have been investigated, quantitative network benefits have been evaluated, and policy measures have been suggested based on these findings is the situation of Catalonia.

In addition to offering helpful policy implications for the development of cities and regions, Boix and Trullen (2004) presented intriguing insights on the link between knowledge, city networks, and growth in regional urban systems. In order to compare the existence of spatially static (agglomeration) and spatially dynamic (network) external economies in an urban growth model, the paper's main objectives are to measure the impact of various types of knowledge on urban growth and to identify the spatial structure of the ambit of analysis (networks of cities). In order to compare the existence of spatially static (agglomeration) and spatially dynamic (network) external economies in an urban setting, the authors develop a methodology in three stages: first, they measure the amount and growth of knowledge in cities using the OCED 2001 classification and employment data; second, they identify the spatial structure of the ambit of analysis (networks of cities); and third, they combine the models with spatial econometric specifications. They discovered that knowledge promotes growth and that knowledge is associated with agglomeration and network externalities in urban areas. The findings on employment growth demonstrate the existence of two concurrent structural processes: the shift from manufacturing to services and the shift to increasingly knowledge-intensive activities. The results, according to the authors, also imply the best areas of focus and contributing elements for enhancing or reforming each sort of knowledge, as well as the best locations for university research facilities.

Rozenblat (2010) addressed how cities' importance in business networks is typically gauged by their standing within the links between global corporations. The multiplier effects that occur within cities are ignored, according to his argument. He proposed that the assessment of city centrality in business networks include intraurban processes including agglomeration economies, social capital developments, and transaction costs. The multilevel method provides better viewpoints for comparing city centralities. The technique reveals benefits for developing major metropolises but inadequate regional impacts for specialized clusters. Firms and households that are situated in agglomerations that are highly integrated into networks that link with other agglomerations might profit from urban network externalities, which are external economies. Burger and Meijers (2016) outlined the concept of urban network externalities and presented a research agenda that should concentrate on multiplexity and heterogeneity in networks and their effects, interactions between agglomerations and networks, and the dynamic, place-based nature of these relationships, as well as the policy implications of urban network externalities. The definition of urban network externalities and their impact on urban performance are the main topics of contributions.

Agglomeration and network externalities are undefined notions that can be merged analytically, but only if a consistent conceptualization and operationalization strategy is used. To aid researchers in precisely analyzing the interplay between agglomeration and network externalities, Van Meeteren et al. (2016) presented a combinatorial typology for agglomeration and network externalities. By using a cutting-edge bipartite network projection to show the presence of multinational producer services businesses in cities in 2012, the typology is demonstrated. Swedish micro-data were used by de De Vos et al. (2020) to investigate whether broadband internet enables smaller communities to benefit from a larger city's labor market advantages. Evidence suggests that broadband penetration in the home is more significant than broadband accessibility there. According to Swedish microdata from 2007 to 2015, broadband internet enables smaller communities to benefit from a larger city's labor market.

Urban network research was studied by Hu and Lu (2020) from the standpoint of the corporate network. They proposed that social, regional, relational, and scale embedding be taken into account in urban network research from the standpoint of enterprise networks. Producer services are crucial to study on urban links and related topics. Future studies of urban networks should prioritize the impact of institutional culture on urban networks and improve the investigation of linkages and various viewpoints. Yang et al. (2021) analyzed the spatial organization and externalities of GBA's knowledge innovation network. The findings demonstrate that Guangzhou and Hong Kong have consistently been the hubs of knowledge innovation in the network, and that Shenzhen only became a center for innovation after 2012. The knowledge innovation network's negative externality suggests that this area needs to reduce regional disparities and optimize the design of the innovation network in order to increase the network externalities. Small- and medium-sized cities were discovered to be imprisoned in the agglomeration shadow of the core metropolis. Institutional and cultural disparities were cited as the key obstacles to intercity innovation collaboration.

In the context of globalization, Zhu et al. (2021) investigated the relationship between city-ness and town-ness. The notions of networked non-local hinter-worlds (central flow theory) and hierarchical local hinterlands (central place theory) are expanded upon and developed in this study to make them particularly applicable to the current corporate globalization. Multi-nodal global city-regions serve as a proxy for the central place process, while capital investment flows between cities serve as a proxy for the central flow process. They discovered that capital movements in big cities boost transfers to nearby smaller cities within their areas.

In order to investigate the connection between urban networks, agglomeration economies, and economic development, Yin et al. (2020) reviewed the relevant literature. They noticed that whereas prior research tended to pay more attention to the effects of agglomeration economies on economic growth, urban network externalities received less consideration. Additionally, inconsistencies in study results were linked to variances in the measuring methods and research scale used to assess MAR (Marshall-Arrow-Romer) and Jacobs' externalities. The researchers also observed a tendency in transportation and economic research toward the substitution of structural model analysis for reduced form models. This study shows the importance of urban network externalities in stimulating economic growth and contrasts them with agglomeration economies in terms of their geographical properties and effects on regional development. Economic externalities known as urban network externalities are produced by interactions between economic agents, even when they are not geographically close to one another. These externalities depend on the strength of the functional linkages between cities rather than being restricted by physical proximity. Urban network externalities are seen as club goods since they only have an impact on the networked cities. Agglomeration economies, on the other hand, are a kind of economic externality that result from the proximity of economic agents. They are restricted by space and tend to get smaller as economic actors are separated from one another (Yin et al. 2020).

2.4 Network Externalities: Agglomeration Shadow and Borrowed Size

The New Economic Geography literature, which seeks to explain the spatial distribution of economic activity and the emergence of regional clusters, is centered on the concepts of agglomeration shadow and borrowed size. Agglomeration is the geographical concentration of economic activity in metropolitan regions, which is driven by an array of elements including economies of scale and knowledge transfer. The term "agglomeration shadow" describes the geographical scope of a city's economic influence, which may extend beyond its administrative boundaries. Concentration of economic activities in certain regions may be advantageous or disadvantageous due to the effects it has on neighboring regions. The interconnection of cities and regions must be taken into account when developing policies and strategies, which has significant implications for regional planning. Another notion that is significant to the literature on NEG is borrowed size. It outlines how smaller cities may use the resources and services of larger cities to access resources and services that are not locally accessible. Given that larger cities often provide more resources and services that smaller cities find appealing, this hypothesis is strongly linked to the theory of agglomeration.

When the literature on the agglomeration shadow and borrowed size concepts is examined, it is seen that Alonso (1973) made the first study and introduced the concept. In particular, the empirical studies of Burger and Meijers (2016), who have conducted the most studies on the subject, have expanded and developed the concepts in recent years. According to Alonso (1973), aging populations, decreased birth rates, and migration are all contributing to the zero-population growth trend in metropolitan regions. The population in certain locations may continue to fall in the near future as a result of this tendency. Reversing this tendency may be made possible by policies and programs that emphasize raising living standards and expanding economic possibilities in metropolitan regions. In this study, Alonso established the idea of "borrowed size" for the first time.

Phelps, Fallon, and Williams (2001) conducted another early research in the borrowing size literature in which they examined the significance of borrowing size factors in the interactions between small businesses in Leighton Linsladed and Lichfield and the surrounding larger metropolitan areas. They discovered that even if they are situated in smaller areas, small businesses may access the specialized labor and informational external economies of surrounding larger urban areas. They also discovered that, contrary to earlier speculation, local institutional support may not be as crucial to the expansion of rural entrepreneurship. The notion of the local economy and local economic policy are affected by borrowed size.

In order to determine if proximity to similar-sized and higher-tier urban centers has an impact on growth patterns, Partridge and Rickman (2009) conducted a study of data on 1990–2006 U.S. County population growth. They discovered that larger metropolitan centers encourage growth in cities nearby with populations under 250,000. They also discovered growth shadows that the largest urban centers cast on nearby medium-sized urban areas (population between 250k and 1.5m). They also emphasized the fact that small urban regions compete with one another for space.

McCann and Acs (2010) claim that during the course of several globalization eras, the significance of agglomeration effects, and particularly the link between city size and the prosperity of the nation-state, has evolved. The importance of multinational corporations for a city-region's worldwide connectedness has increased in the current era of globalization. In developed nations, a city's size is significantly less important than its degree of global connectedness.

Burger and Meijers (2014) examined the ways in which network economies enable cities to borrow size at various geographic scales. The presence of urban functions was quantified, and high-end cultural amenities were used as approximations along with conceptualization and empirical investigation of the notion of "borrowed size." They discovered that for locations in North-West Europe, size and function are connected, with the biggest locations in their functional urban area (FUA) being better able to utilize their own mass and borrow size from surrounding locations and through (inter)national urban networks than the lower-ranked locations. The size of a location and the functions it performs are not always related in networked constellations since the critical mass needed to sustain certain functions can be found in the larger metropolitan network.

In the urban system of Western Europe, agglomeration shadows in networks of cities are becoming more and more significant. Burger and Meijers (2015) conducted another important study to determine if the current dynamics in the urban structures of Western Europe are caused by the expansion of "city network economies," which has resulted in processes of borrowed size and the emergence of agglomeration shadows in networks of cities. They examined the distribution of metropolitan functions across Western European cities and demonstrated how size and network connection matter differently for various metropolitan functions and for various cities. They discovered that while local size continues to be the most important factor in determining the occurrence of most types of functions, network connection significantly boosts the prevalence of metropolitan functions. On the other hand, because it has competing impacts for nearby cities and more often affects smaller cities due to agglomeration shadows, regional network connection is not always advantageous.

Maly (2016) focused on the service function of small towns while examining the effects of network externalities on urban function. The research illustrates how the positioning of small towns within a regional urban system affects the supply of services using the case of the South Moravian Region (Czech Republic). The findings highlight how important an area's tourism and commercial appeal is to the supply of services in the final phase. The distribution of services among small towns within a regional urban system that is heavily influenced by a metropolitan center dictates how much is provided.

The borrowed size concept demands a recasting of the geographical foundations of agglomeration theory. Burger and Meijers (2016) suggested that the concept of borrowed size must be stretched in terms of scale and scope to enhance its policy value (Table 2.1). Borrowed size occurs when a city possesses urban functions and/or performance levels normally associated with larger cities. This is enabled through interactions in networks of cities across multiple spatial scales. The geographical underpinnings of agglomeration theory must be reformulated in light of the borrowed size concept. Burger and Meijers (2016) hypothesized that in order to increase the idea of borrowed size's policy value, it must be broadened in scale and scope. When a city exhibits urban functions and/or performance levels commonly associated with larger cities, it is said to be borrowing size. Interactions among cities in networks at various spatial dimensions make this possible.

Table 2.1 : Dimensions of borrowed size (Burger and Meijers, 2016).

Dimesions of Borrowed Size		Connection Size ← → Function	
		Fewer functions than expected given size	More functions than expected given size
Connection Size ←→ Performance	Performs less well than expected given size	Agglomeration Shadow	Borrowed Functions
	Performs better than expected given size	Borrowed Performance	Borrowed Size

To determine whether tighter integration could enhance agglomeration advantages at the PUR-level, Cardoso, Hoogerbrugge, and Meijers (2018) conducted a cross-sectional analysis of PURS, measuring the degree of functional, institutional, and cultural integration as well as the existence of metropolitan functions. They discovered evidence that polycentric urban areas operate better when all aspects of integration—functional, institutional, and cultural—are present. Functional integration is the dimension that matters most in terms of performance out of all the other aspects. In terms of institutional integration, the existence of some sort of metropolitan cooperation is more crucial than its precise form.

In order to investigate the effects of the industrial structure of core cities on regional urban systems, Li and Sun (2020) measured population growth in 6 core cities along with urban systems in China. They discovered that manufacturing has a favorable impact whereas services have a large negative impact on market potential. The findings show that service industries have a higher propensity to cast an agglomeration shadow over non-core cities. By analytically examining and operationalizing the borrowed size notion, Volgmann and Rusche (2019) provide new information about the relationship and spatial distribution of four different types of effects: borrowed size, borrowed performance, borrowed function, and agglomeration shadow. The small-scale spatial research on these geographical impacts includes all municipalities in German urban zones.

In order to measure the advantages and disadvantages of this integration as well as the patterns of uneven development, Cardoso and Meijers (2021) created a framework to capture and characterize the evolving spatial organization in the process of metropolitan integration (Table 2.2). The research expands on the ideas of "borrowed size" and "agglomeration shadows" to explore the latest relationships and dependencies between the cities that comprise multicentric urban areas. By investigating cities in Randstad Holland (120 municipalities), factors connected to "agglomeration shadow" or "borrowing size" positions have been identified. During the process of metropolitan integration, uneven patterns of development were evident.

Table 2.2 : Dimensions of borrowed size (Extended by Cardoso and Meijers, 2021).

Dimensions of Borrowed Size		Connection Size ← → Function		
		Fewer functions than expected given size	As many functions as expected	More functions than expected given size
Connection Size ←→ Performance	Performs less well than expected given size	Agglomeration Shadow	Performance Shadow	Borrowed Functions
	Performs as expected	Functional Shadow	As Expected	Borrowed Functions
	Performs better than expected given size	Borrowed Performance	Borrowed Performance	Borrowed Size

To summarize, agglomeration shadow and borrowed size are new economic geography's two cornerstone concepts. New economic geography, a field of economics that emerged in the 1980s and 1990s, and still being the fundamental reference, is the study of the spatial distribution of economic activity and how factors like transportation costs, agglomeration economies, and regional policy affect it. The negative externalities that arise when economic activity is concentrated in one specific region are referred to be "agglomeration shadows". This could occur, for example, when a major city or region attracts an excessive quantity of capital and talent, casting a "shadow" over neighboring places that consequently see a fall in economic activity. There could be unfavorable externalities like increased traffic, pollution, and higher prices for products and services as a result of particular companies' dominance in the market. Contrarily, the idea of borrowed size describes the positive externalities that result when businesses in a smaller region profit from the existence of bigger, more productive businesses in surrounding areas. This can arise when smaller companies in a region gain access to specialized inputs or knowledge transfers from larger companies in a neighboring city or region, increasing productivity and competitiveness.

Because of agglomeration externalities, such as the variety of opportunities, services, infrastructure, and skills accessible to companies and individuals, theoretical models of the new economic geography tend to forecast the development of smaller and larger cities (Fujita et al. 1999). These externalities are generally more prevalent in larger cities (Melo et al. 2009). NEG models appear to be failing to explain contemporary population and growth dynamics, particularly for advanced, developed urban systems, notwithstanding their historical success in explaining developments in the urban system (Glaeser and Kohlhase 2004; Partridge et al. 2009).

Dijkstra et al. (2013) have sought for reasons within Europe's polycentric urban structure, the progressively improved access to services, such as Internet, outside the large cities, and agglomeration diseconomies in the large cities enhancing the attraction of smaller cities. In this context, McCann and Acs (2011) even make the case that, in the modern world, urban connectivity on a national and international scale is more important to urban performance than urban size. In a similar vein, Bel and Fageda (2008) concluded that international airline networks are a significantly more important determinant of where corporate control functions are located than urban and national level, while Ni and Kresl (2010) contend that global connection is the most significant factor in determining the global competitiveness of cities. This shows that small and medium-sized cities now have the ability to compete with bigger ones as long as they are properly linked, in addition to the fact that being integrated in regional, national, and global networks is vital for urban performance.

As the term "agglomeration economies" implies, agglomeration externalities may not be constrained to city boundaries but instead be shared throughout networks of cities. Cities that are well-positioned within networks may be able to "borrow size" from other cities through these networks, which might help cities compensate for their relative lack of mass or size (Alonso, 1973). If this were the case, "city network externalities" would replace or complement "agglomeration externalities". Burger and Meijers' (2016) study examines whether networks are enhancing local elements in the development of what is known as "urbanization economies," with an emphasis on the existence of higher-order metropolitan functions linked to business, science, sports, and culture as surrogates for these urbanization economies.

Cities that are larger, denser, and more diversified allow cost reductions, output improvements, and utility benefits for both companies and residents. They benefit from broader input markets, larger labor pools, greater infrastructure, city services, and more specialized business services, all of which help supply and demand to match more effectively. Universities, R&D centers, and other knowledge-generating organizations are therefore more likely to be located in large cities, which also make it easier for information to be transferred and provide a favorable atmosphere for consumption (Van Oort, 2004). Also, the often varied industrial mix in large cities encourages the creation, duplication, modification, and recombination of ideas and applications across various sectors by providing greater chances through in-person interaction and protecting a city from a volatile demand (Frenken et al. 2007).

Due to the high employment and population density, there is more rivalry for centrally located properties, which results in traffic congestion, environmental pollution exposure, and crime. Also, social problems emerge on a larger scale, making it difficult to simply handle them. According to the evidence, smaller cities seem to have a higher endogenous capacity to reduce these social, economic, and environmental costs (Capello and Camagni 2000).

It is significant that some scholars have argued that agglomeration costs are more limited to city boundaries than agglomeration benefits (Meijers and Burger, 2016). It is yet unknown, though, if urbanization economics may be shared in networks across cities. In addition, there is a more common argument that network economies can replace the role of agglomeration economies. Seen from this angle, it is probable that these urbanization economies are becoming more and more dependent on regional factors (like size and density) and instead need to be interpreted from a network perspective.

The idea of "borrowed size," first put forth by Alonso (1973), was an early contribution that also viewed urbanization economics from a network perspective, but on a much smaller, regional scale. A system of cities has many facets, but one of particular interest is the concept of borrowed size, which states that a small city or metropolitan area exhibits some of the characteristics of a larger one if it is close to other population concentrations. He used this concept to explain a disconnect between the size and function of smaller cities that were part of a megalopolitan urban complex. To put it more simply, he advocated for smaller urban areas to "borrow" some of the agglomeration advantages from their larger neighbors while avoiding the costs of agglomeration. Since Alonso (1973) mainly focused on borrowing size of spatially nearby areas, his argument may be easily extended to city networks in general and not just entail regional network connectivity but also global network connectivity in today's ever-expanding international economy.

Smaller areas can "borrow size" and host functions that they would not have been capable of hosting independently due to the presence of spatial interdependencies. In order to explain this discrepancy between the size and function of smaller cities that were part of a megalopolitan urban complex, Alonso (1973) developed the idea of borrowed size. The idea of a system of cities has many components, but one in particular is the idea of borrowed size, which states that if a small city or metropolitan region is close to another large city, it will reflect some of the features of a larger one.

More specifically, he contends that smaller cities may "borrow" some of the benefits of agglomeration from their larger neighbors while incurring the costs associated with agglomeration. Way back in the 1970s, Alonso recognized that borrowed size was a critical problem to comprehending the urbanization pattern of North-West Europe, himself alluding to the trend of urbanization in the North-Eastern USA. Many

European urban patterns, including those of Germany and the Low Countries, whose cities are rather small by our standards, appear to reach adequate scale for the operation of a modern economy by borrowing size from one another, also demonstrate processes of borrowed size. By reframing the challenge of a city's size and growth to partially encompass its neighbors, this phenomenon changes the way it is seen (Alonso, 1973, p. 200).

A borrowed size effect for one location indicates that one or more other areas are in an agglomeration shadow because of this relationship. In other words, rather than these smaller cities borrowing size from their larger neighbor (as anticipated by the New Economic Geography), larger cities often cast a shadow over smaller neighboring cities (as suggested by Alonso). According to this study, the largest cities within a FUA (functional urban area) benefit more from the size of the surrounding region and from having access to a huge (inter)national population. Since they are more likely to be in the shadow of a first-rank city and experience the impacts of spatial rivalry, the lower order areas are not the largest cities in the FUA—are less likely to borrow size from other places. As a result, large cities benefit most from the effects of borrowed size, while small- and medium-sized areas in Europe often flourish in isolation (Burger and Meijers, 2015).

2.5 Empirical Studies on Network Externalities and Borrowing Performance

Since it is thought to be the most appropriate article for this thesis in terms of theoretical and conceptual framework, this study of Burger and Meijers (2016), who has done the most empirical work in the literature on the subject, in which they examine urbanization economies from a network perspective, is also a reference and guide in the methodology part. In order to determine whether networks are enhancing local factors in the development of what is known as "urbanization economies," Burger and Meijers focus on the presence of higher-order metropolitan functions related to business, science, sports, and culture as surrogates for these urbanization economies.

Burger and Meijers (2016) chose specific variables representing different domains of metropolitan functions, which included 'international institutions', 'firms', 'science', 'culture', and 'sports'. These variables encompassed factors such as the presence of UN offices, EU institutions, top-500 firms, advanced producer services, cultural events, and sport venues. They also employed an index that aggregated these indicators after normalization to create an overall measure of metropolitan functions. This index was calculated by summing the normalized scores across the five domains and dividing by the number of indicators. The authors collected data on metropolitan functions at the local area unit (LAU) 2 level, but due to the detailed nature of this level, they associated these codes with broader territorial delimitations provided by the ESPON research programme. This involved morphological urban areas, functional urban areas, and potential urban strategic horizons. They focused on 16 European countries for analysis, using urban agglomerations as their unit of study.

In terms of measuring regional network connectivity and (inter)national network embeddedness, the authors utilized the size of the population reachable within a 45-minute travel time by various modes of transport, excluding the city itself. This measure was referred to as the 'potential urban strategic horizon' (PUSH) area. To explain the presence of metropolitan functions, the authors incorporated control variables including GDP per capita, a 'capital city' indicator, and a tourism index. These variables were used to account for economic affluence, institutional status as capital cities, and the impact of tourism on supporting metropolitan functions. Additionally, they introduced country dummies to consider institutional differences across countries. Regarding their methodology, Burger and Meijers (2016) employed a zero-and-one inflated beta regression to model the presence of metropolitan functions. The dependent variable, an index ranging from 0 to 1, was not suitable for ordinary least squares (OLS) due to its characteristics. The authors utilized the beta distribution to accommodate both binomial and non-binomial responses, along with an extra parameter (phi) to address overdispersion. They focused particularly on the zero-inflated part of the model, acknowledging the likelihood of population thresholds for specific metropolitan functions. This approach accounted for the probability mass at 0 in their data.

Another relevant empirical study of the duo is the evaluation of the concepts of borrowed size and the agglomeration shadow in the context of cultural assets. In their study, Burger and Meijers (2015) investigate the moderating impact of network position on the connection between a place's size and the amenities it offers. They employ data from the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR, 2011), which covers metropolitan functions in European locations (mostly defined at LAU-2 level). Focusing on cultural events and venues across 2794 West-European cities, towns, and villages during 2006–2007, the researchers quantify the presence of cultural amenities using a composite index. This index is constructed from six indicators, such as the number of theaters, opera houses, music events, public art institutions, art fairs, film festivals, and art galleries.

The selected variables reflect the extent of cultural amenities in a place. The authors assign a score to each place, with the highest-scoring city receiving a value of 1, and other places relative to the top-ranked city. The study's dataset encompasses a range of population sizes, from small villages to large cities, primarily located in France, Germany, Switzerland, the Netherlands, Austria, Belgium, and Luxembourg. To comprehensively assess the impact of population size, the researchers account for local population (LAU-2), population within the functional urban area (FUA), and accessibility to a broader national and international population. They also incorporate control variables like the presence of UNICEF heritage sites, GDP per capita at the FUA level, and country-specific factors. Their analysis encompasses 417 functional urban areas containing places within a maximum radius of 60 kilometers to consider local proximity. To quantify national and international accessibility, the authors employ an accessibility measure considering road, rail, and air transportation, acknowledging travel time. Notably, the study examines whether size effects, urban network economies, or spatial competition effects are present, guided by the place's position within the wider urban network.

The empirical model utilized to study these relationships employs a beta regression framework due to the bounded nature of the Cultural Amenities Index. The index ranges between 0 (no amenities) and 1 (highest amenities score). The beta regression accommodates the characteristics of the data and the probability concentrations at the boundaries. The model encompasses three components: logistic regression for the likelihood of zero or one, and a beta regression for proportions between 0 and 1. Additionally, they address zero-inflation to account for instances where a place lacks high-end amenities. In summary, Burger and Meijers select specific variables to explore the connection between network position, place size, and cultural amenities. Their chosen methodology involves a composite index, beta regression modeling, and careful consideration of local and broader population dynamics, aiming to understand the nuanced relationships between these factors.

Burger and Meijer's related studies was expanded upon by Cardoso and Meijers (2021), who employed a descriptive methodology to examine the relationship between six potential characteristics and the categorization of cities as either borrowing performance, functions, size, or confronting a performance or functional shadow. Historical significance, size, the sectoral mix of the local economy, societal status, network embeddedness and tourism are the six criteria taken into account. This approach was chosen by the authors to investigate the intricate and varied nature of the connections between primary and secondary cities in dynamic metropolitan areas. Additionally, they indicate that there are other options to go into greater detail about the factors, such as taking network embeddedness on various spatial scales or the intensity of linkages to simply the first city, into account.

According to Yin et al. (2020), an urban network is a system of spatial organization that connects cities through a variety of economic and social relationships and creates externalities through the complementing integration or synergy between the nodes of the connected cities. In contrast to agglomeration economies, which are confined by physical closeness, urban network externalities, only affect linked cities. The researchers used complicated network methodologies and data from train flows to examine China's nationwide urban network. They measured and evaluated the properties of the urban network using metrics including network density, degree centrality, closeness centrality, and the block model method. Based on train frequency, the degree centrality and closeness centrality of each node were determined. Urban network externalities and agglomeration economics were factors incorporated in the empirical model developed utilizing the Spatial Durbin Model parameters. The results showed that urban network externalities significantly contribute to encouraging urban economic development. Cities with stronger in-closeness centrality—a network indicator of a key position—tended to have faster economic growth. Importantly, urban network externalities rely on network connections rather than being restricted by proximity to create cross-spatial spillover effects. Comparatively speaking, metropolitan network externalities had a stronger influence on economic growth than did agglomeration economies, based on this study.

Another similar research, by Sohn, Licheron, and Meijers (2022), estimates the influence of nearby cities and the moderating effects of borders on the performance of metropolitan regions in Europe using a spatial autoregressive model (SAR). The research attempts to discover the variables that contribute to the success of border cities that have escaped from the shadow of their surrounding cities and to give insights into the benefits and drawbacks of being in the area of influence of other cities. The paper makes suggestions for decision-makers and urban planners while also examining the impact of agglomeration economies and functional diversity on metropolitan performance. The variables used in the study are divided into dependent and explanatory variables. GDP per capita serves as the dependent variable, which represents metropolitan performance. Measures of city size, population growth, functional variety, and the existence of supranational organizations are among the explanatory factors. Additionally, the research contains control variables that reflect the characteristics of nations and cities, such as population, status as a capital city, and the existence of supranational organizations. The European Urban Audit, which encompasses 271 metropolitan regions across 28 European nations, provided the data for the research.

Some scholars contend that interventions that promote more connectedness and knowledge spillovers across surrounding regions, such as investing in transportation infrastructure or creating innovation networks, can reduce the negative externalities of agglomeration shadow. Others have stated that in order to combat the negative consequences of agglomeration shadow, initiatives targeted at dispersing economic activity may be required. Yet borrowed size is sometimes seen as a benefit that may be used to enhance the competitiveness of smaller places.

Examples of policies that can assist in reducing the productivity gap between surrounding regions include those that promote collaboration between large and small companies or that provide greater opportunities for knowledge and technology to spread across nearby regions. The advantages of borrowed size may not, however, be dispersed equally across areas, so measures that encourage regional cooperation should be carefully crafted to avoid aggravating already-existing disparities. In general, the ideas of borrowed size and agglomeration shadow are essential to comprehending the geographical distribution of economic activity and the variables affecting regional competitiveness. Policymakers and academics alike can benefit from greater knowledge of these concepts' dynamics in order to create successful policies targeted at fostering economic growth and minimizing regional inequalities, despite the complexity and context-dependence of their connections.

The largest metropolitan area in Turkey and one of the most populous cities worldwide, Istanbul is a megacity with a population of over 15 million. With a wide variety of businesses, including manufacturing, banking, and tourism, the city is a significant economic hub for Turkey and the surrounding area. As a result, it has a substantial agglomeration effect that absorbs inhabitants, money, and resources from nearby cities and regions. This agglomeration effect is known as the "agglomeration shadow," and it refers to the spatial range of influence of a city's economy, where its activities and economic performance spill over into surrounding regions.

Istanbul's network externalities, which enable the city to gain from its connections to other cities and regions, are one of the main factors sustaining its growth and development. Istanbul is capable of attracting more investment, providing more opportunities, and enhancing economic activity than it could on its own because of its strong connections to other cities through trade, communication, and transportation networks. Moreover, due to their ability to access Istanbul's resources and new opportunities, the city's neighboring areas also profit from these network externalities.

Istanbul's size and global influence enable it to impact the growth of its neighboring cities through borrowed size in addition to the agglomeration shadow. By utilizing the resources and services of a larger city, a smaller city can obtain resources and services that are not readily available locally. In the example of Istanbul, its size and economy could enable it to provide resources and services to its neighboring cities, some of which might not be able to do it on their own. Given the smaller cities' reliance on Istanbul for resources and services that are not readily available locally, Istanbul's borrowed size may also encourage cooperation and interdependence among them. Due to their interconnectedness, cities may have more opportunities for regional cooperation and coordinated planning as they utilize and optimize their resources to confront development challenges.

The quality of life in such places is expected to be affected by the premise that Istanbul's agglomeration shadow and borrowed size have a substantial influence on the growth of its neighboring cities. On the one hand, as surrounding cities compete more fiercely to attract resources and investment, the quality of life may improve as a result. The residents of these cities may benefit from investments made in public services like healthcare, education, and infrastructure. On the other hand, the surrounding cities' dependence on Istanbul for resources and services might be detrimental to the standard of living there. For instance, if Istanbul's resources and services are too concentrated in the city, the neighboring cities may lack investment and resources, which would lower the quality of life for citizens.

As a result, it is possible to speculate that Istanbul's agglomeration shadow and borrowed size have a big influence on the growth of its neighboring cities. While borrowing size may encourage cooperation and interdependence among the cities as they depend on Istanbul for resources and services, the agglomeration shadow may result in increasing rivalry among the neighboring cities as they compete for investment and resources. Istanbul's connection with its neighboring cities is expected to be complex overall, having both positive and negative effects. The particular processes through which Istanbul's agglomeration shadow and borrowed size influence the growth of its neighboring cities, as well as the consequences of this connection for regional development and planning, require further research.

2.6 Previous Studies on Network Connectivity in Turkey

The interactions of cities in Turkey with each other, the flow of information, goods and services through the network relations they have established are important in terms of creating spheres of influence that feed each other, and increasing their performance through interactions. Socio-economic relations between provinces were examined separately by YERSIS with secondary education, higher education, health, transportation, trade, cargo and communication variables, and integrated network relations analysis was carried out to examine these interactions. Within the scope of the study, the centrality status of the provinces in the integrated network structure was examined by calculating the inner degree, outer degree, in-betweenness and eigenvalue centrality and geographical scatter index. The converged network is a dense network like any other network it contains. In this network, which takes the maximum density value, each settlement has definitely connected with each other. The average travel distance to access services across the network was 399 km. It is seen that the integrated network is closest to the trade and communication network in terms of average service access distance. It is seen that the strongest relationship in the integrated structure is between Istanbul and Ankara.

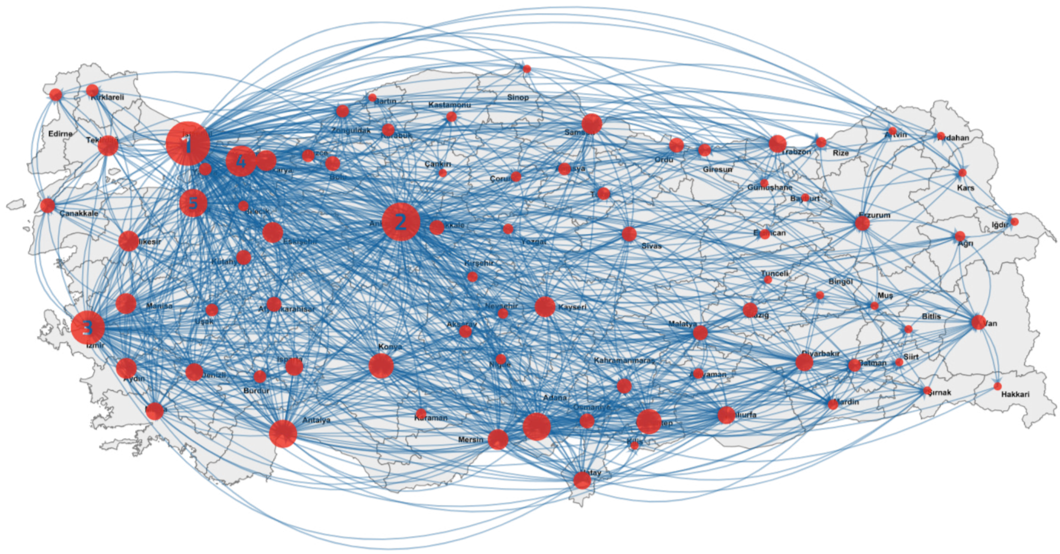

Figure 2.2 : Top 1000 relationships in the integrated network (Source: YERSIS).

According to the standardized data, 201 out of every ten thousand flows were from Istanbul to Ankara, followed by the flows from Ankara to Istanbul with 147 flows per ten thousand (Figure 2.2). In the first 50 relations, Istanbul's strong mutual relations with Ankara, Kocaeli, İzmir, Bursa, Tekirdağ and Sakarya stand out (YERSIS, 2020). When the top 50 strongest ties are examined, it is seen that the majority of the ties are directed to Istanbul, and there are mutual ties between Istanbul and Tekirdağ, Bursa, Kocaeli, Sakarya, Samsun, Balıkesir, Ankara, İzmir and Konya. Apart from these, İzmir and Ankara, Manisa and Aydın; There are also mutual ties between Mersin and Adana (Figure 2.3). In addition, it is seen that the networks that were one-way to Istanbul in the first 50 relations became mutual. Cities such as Ordu, Trabzon, Sivas, Diyarbakır, Malatya, Gaziantep and Kayseri can be given as examples to this situation (Figure 2.4).

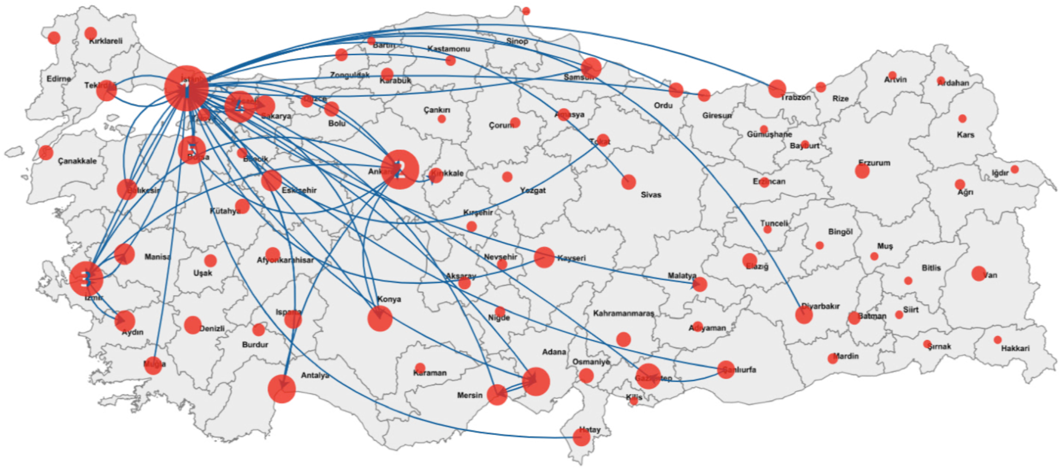

Figure 2.3 : Internal degree centrality and top 50 relationships in the integrated network (Source: YERSIS).

On the other hand, Şanlıurfa, Van and Erzurum were also included in the top 100 relations with their flows to Istanbul (Figure 2.4). Although the number of relations has been increased to 200, it is seen that cities with small population such as Tunceli, Bingöl, Bitlis, Artvin, Ardahan, Kars, Gümüşhane, Bayburt, Iğdır, Uşak, Niğde and Kırşehir do not have ties in the first 200 relations (Figure 2.5).

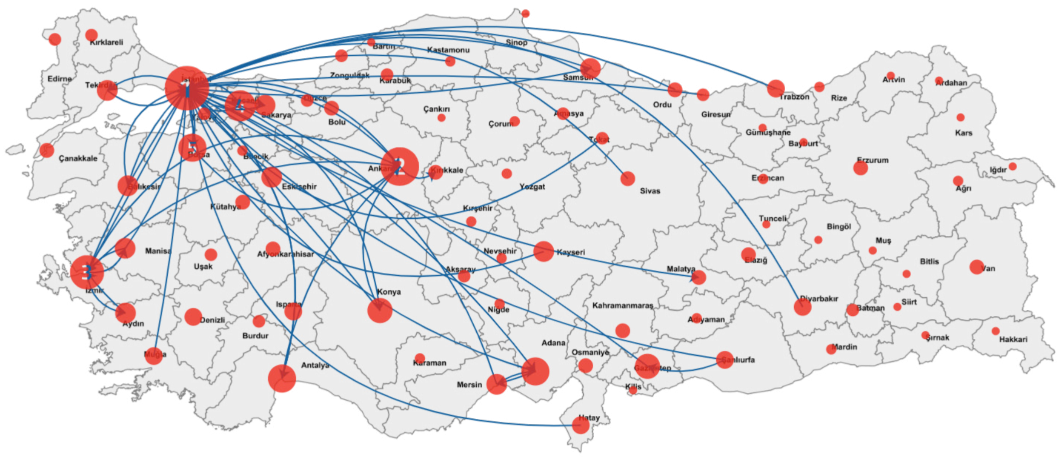

Figure 2.4 : External degree centrality and top 100 relationships in the integrated network (Source: YERSIS).

In addition to Istanbul's central role, Ankara has also established strong ties with the surrounding provinces and major centers. However, clusters centered in İzmir in the Aegean Region, Antalya and Adana in the Mediterranean Region, and Gaziantep in Southeastern Anatolia attract attention (YERSIS, 2020).

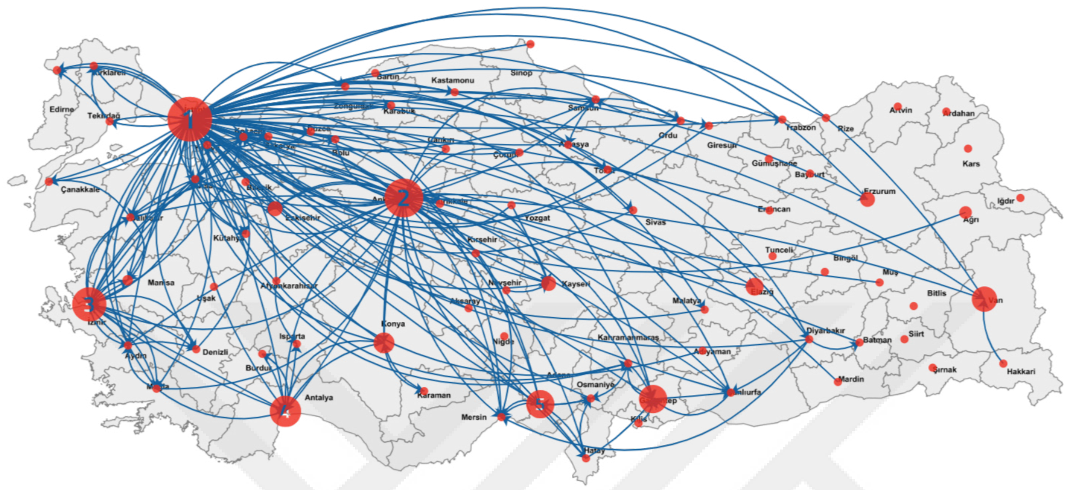

Figure 2.5 : Betweenness centrality and top 200 relationships in the integrated network (Source: YERSIS).

To summarize, according to the top 1000 and top 50 relationships in YERSIS' integrated network analysis, the strongest primary-secondary city relations are as follows: Istanbul-Kocaeli, Bursa, Tekirdağ, Sakarya, Samsun; Ankara-Eskişehir, Konya, Kayseri; İzmir-Balıkesir, Manisa, Aydın; Adana-Mersin, Gaziantep (Figure 2.2).

Several studies have investigated the dynamics of network connectivity in Turkey, with a focus on the interdependencies between metropolitan and second-tier cities. These studies have examined the impact of transportation infrastructure, such as highways and railways, on regional development and economic performance (Şeker, 2020). Others have explored the role of telecommunications infrastructure and information and communication technologies (ICTs) in fostering connectivity and facilitating knowledge diffusion. While these studies have contributed to the understanding of network connectivity in Turkey, there is a need for more comprehensive research that specifically examines to what extent network connectivity benefits second-tier cities and enables them to enhance their urban performance through borrowed size.

2.7 Chapter Conclusion

In summary, the theoretical and conceptual framework combines the theories of New Economic Geography, Agglomeration Economies, and Network Economies with the concepts of agglomeration shadow and borrowed size. In the context of Istanbul, Izmir, Ankara, and their surrounding second-tier cities in Turkey, the relationship between network connectivity and urban performance can be explained through these theories and concepts. Network connectivity enables second-tier cities to overcome the agglomeration shadows caused by the concentration of resources in metropolitan cities. By accessing the resources, investments, and knowledge available in metropolitan centers, second-tier cities can enhance their economic performance, attract investments, foster entrepreneurship, improve education, and increase employment opportunities. The extent to which second-tier cities can benefit from network connectivity and achieve urban performance depends on the strength of their network infrastructure, transportation nodes, and telecommunications systems, as well as the policies and strategies implemented to promote connectivity and regional development.

In Turkey, second-tier cities surrounding Istanbul, Izmir, and Ankara have experienced significant population growth and economic development. These cities seek to leverage their proximity to the metropolitan centers and their network connectivity to enhance their own urban performance. Agglomeration economies refer to the benefits that arise from the concentration of economic activities in a specific geographic area. These benefits include knowledge spillovers, labor market pooling, access to specialized inputs and services, and economies of scale. In the case of Istanbul, Izmir, and Ankara, their status as major metropolitan cities in Turkey attracts investments, skilled labor, and knowledge-intensive industries. These agglomeration economies result in a concentration of resources and opportunities, which can create agglomeration shadows in the surrounding areas. New Economic Geography theory provides insights into the spatial distribution of economic activities and the factors that shape regional development. According to this theory, the agglomeration of economic activities in certain locations, such as metropolitan cities, is driven by various forces such as economies of scale, transportation costs, and agglomeration economies. It suggests that the concentration of economic activities in a particular area creates positive externalities that enhance productivity and innovation. In the context of Turkey, Istanbul, Izmir, and Ankara represent the metropolitan cities that exhibit strong agglomeration effects.

An intriguing phenomenon that may be linked to the agglomeration shadow and borrowed size is the rise of secondary cities around Istanbul. Individuals, families, and firms have started searching for alternatives to Istanbul as it has developed, become more crowded, and become more costly. Secondary cities that are close to Istanbul have grown as a consequence, and they may profit from the economic activity of Istanbul. Yet, regional planning and development also encounter obstacles as a consequence of the rise of secondary cities. These cities must be incorporated into a larger regional development strategy that considers the interconnection of cities as well as the impacts of agglomeration and borrowed size if they are to develop sustainably and offer their citizens high-quality living environments. Overall, there are both positive and negative effects on the quality of life in Istanbul's neighboring cities, making the connection between those cities and Istanbul multifaceted and complex.

Network externalities play a crucial role in the interaction between second-tier cities and metropolitan cities. In the context of second-tier cities in Turkey, the degree of network connectivity with Istanbul, Izmir, and Ankara becomes crucial in determining their ability to benefit from network economies. Strong network connectivity can enable the borrowing of size, resources, and knowledge from metropolitan cities, mitigating the effects of agglomeration shadows. Agglomeration shadows occur when the concentration of resources and investments in a metropolitan city limits the development of surrounding areas. On the other hand, borrowed size refers to the ability of second-tier cities to access resources, investments, and knowledge from metropolitan cities through network connectivity, thereby enhancing their own urban performance. The network connectivity between second-tier cities and Istanbul, Izmir, and Ankara becomes a crucial factor in determining the extent of borrowed size and its impact on the urban performance of these secondary cities.

3. METHODOLOGY

The research technique used to examine the network connection between Turkey's second-tier and metropolitan cities, as well as its effects on the urban performance of second-tier cities, is presented in this chapter. The research design, data collecting methods, variables, and statistical approaches are described in detail in this chapter in order to test the hypothesis and meet the study's objectives. The methods and parameters of the studies in the relevant literature were examined, and the parameters used to measure network connectivity and urban performance were summarized.

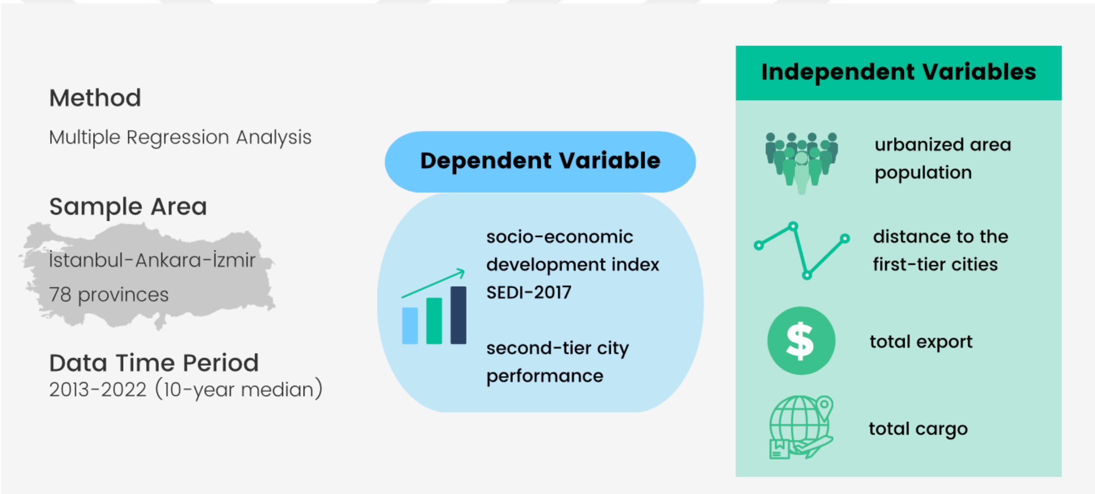

Figure 3.1 : Methodological approach design scheme.

Agglomeration economies, which constitute the theoretical framework of the study, agglomeration shadow and borrowed size concepts, which are extensions of the new economic geography theory, and the advantage of network externalities to secondary cities, will be tried to be explained with different models in this section. By extending the concept of borrowed size to the concept of borrowed performance and borrowed function (Cardoso and Meijers, 2020), it is investigated how much secondary cities are included in regional and national networks, and whether the advantages of being included in these networks are more important than size and proximity. In this context, model experiments were carried out with network connectivity, proximity and size data, and the best model was reached. The research method was designed in line with this theoretical framework and conceptual scheme (Figure 3.1), and the variables were determined with reference to relevant studies in the literature.

The data set selected to measure the performance of secondary cities is the "Socio-Economic Development Index of Provinces" published by the Ministry of Industry and Technology of the Republic of Turkey in 2017, and the development ranking of the provinces, which is the output of this study, is included in the analyzes as a dependent variable. It has been seen in the literature that the parameter of gross domestic product per capita is frequently used to measure the performance of cities, but recent studies have shown that GDP, which corresponds only to the monetary value of economic activities, that is, the market value of all final goods and services produced and sold by a country or country in a given period of time, is not a sufficient value to measure the performance and livability of cities. Indicators such as the Gini coefficient and the Palma coefficient are a more consistent measure of gross domestic product per capita by revealing income inequalities in countries. Increasing income inequalities in Turkey in recent years can be seen more clearly through these indicators. In the process of investigating the parameters to be included in the analysis of this thesis, national and international studies related to the subject were scanned, and since it is frequently encountered that gross domestic product is used in performance measurement, a model trial was carried out in which the dependent variable is gross domestic product within the scope of the thesis. At the beginning of the thesis, all accessible data that may affect secondary city performance and livability were collected and an index was intended to be prepared. However, since it was not as comprehensive as the SEGE-2017 study and limited data were available, the prepared index did not give consistent results. Therefore, the Socio-Economic Development Index of Provinces 2017 study has been accepted as having the most appropriate data set for secondary city performance, which is the dependent variable of this thesis study. Parameters affecting the SEGE ranking, which consists of 52 parameters in total; demographic, education, health, competitive and innovative capacity, financial, accessibility, quality of life.

While determining the independent variables, the factors affecting the performance of a city and the extent of its functionality were investigated. It is known that being close to big cities is very advantageous for peripheral cities, as it means being close to the regions where economic activities are piled up. However, not every peripheral city can benefit equally from these agglomerations. The factors that affect this depend on local factors such as the size of the cities and how close they are to big cities. Cities with strong local capacities also have a high capacity to benefit from the benefits provided by large cities, but this may vary from region to region. When the reasons for this variability are investigated, discussions in recent studies have shown that it is no longer always enough to be close to the centers where economic activities are concentrated, or to be a city with a large population located on the periphery of these centers, because the rules and returns of the 21st century are now valid in economic flows. The rapid development of information and communication technologies has also affected the issue of transportation costs, which is the basis of agglomeration economies. The necessity of a network connectivity and infrastructure that will complement the local capacities of cities and further develop them so that they can perform and function higher than their competitors comes to the fore. While this network connectivity is strengthened in line with infrastructural requirements such as transportation, communication, information flows, and internet, commercial flows between cities are further intensified by the presence and strength of these infrastructures. At the same time, the qualified workforce with master's, doctorate and more advanced graduate weight, the capacity to distribute and manage this workforce consistently in the region, the potential of the region to attract investment and the presence of foreign investments in the region are also important. If this issue is mentioned in the case of global cities, the benefits that the city-regions of New York, London and Tokyo have embedded in national and international networks have greatly improved the secondary cities located on the periphery of these cities. According to Sassen (1999), although these 3 cities are very far from each other in terms of distance, they have intensified both the interaction between each other and the global trade flows with the network they have created.

Although the city-region literature is not included in the scope of this study, it provides a good basis for understanding globalization and network relations. In addition, for Turkey, Istanbul has the potential to become a city-region in terms of its own regional, national and international relations. At the beginning of this study, since the issue of Istanbul's special status and the relations it established with Ankara and Izmir directing the country's economy attracted attention, it was aimed to investigate the sphere of influence of this trio. The parameters that affect this sphere of influence and these interactions, and therefore the performance of secondary cities in the spheres of influence of Istanbul-Ankara-Izmir; It has been deemed appropriate to determine the size of the population of the urbanized area, the distance to the primary tier cities on the basis of kilometers, total exports, and the total number of cargo carried on domestic and international lines. The population of urbanized areas is a more appropriate measure of the total provincial population, and the kilometers to the cities of the first-tier determined for proximity are the distances of highways. Total exports and the number of national/international transported loads are selected parameters to measure network connectivity, and in addition to these, model trials were carried out with mobile data, but mobile data was excluded from the main model because it disrupted the linearity in the models.

The concepts of agglomeration shadow-borrowed size will be evaluated in the context of the performance of secondary cities according to the result of the regression analysis. Although it is not possible to directly explain the concepts of agglomeration shadow and borrowed size as a result of multiple regression analysis models, the SEGE2017 ranking of secondary cities will be compared with the Network Connectivity ranking of YERSİS Integrated Network Analysis output. Secondary cities, which are close to the Istanbul-Ankara-Izmir trio but have shown poor performance in the rankings and can be considered overshadowed by the agglomeration in the region, can be determined by comparing these rankings. On the other hand, the concept of borrowed size can be explained for secondary cities that are not close to this trio, but are included in the network of the trio and have shown higher performance than the cities that have the advantage of proximity in the rankings.

3.1 Hypothesis

The primary hypothesis of this study is that network connectivity of second-tier and metropolitan cities in Turkey enables second-tier cities to enhance their urban performance by borrowing size through these networks. According to the hypothesis of the study, the expected result of the model is that the parameters affecting secondary city performance are network connectivity parameters rather than population size and distances to primary cities, which is widely discussed in the literature. In this way, the model will make sense of the discussion of "borrowed size" and "borrowing performance embedded in networks".

While the concepts of agglomeration shadow and borrowed size, which constitute the research setup of the thesis, are explained in the context of secondary city performance, which network connectivity parameters have the most impact on secondary city performance and how network connectivity appears as borrowed performance and/or function in secondary cities, the research questions will be answered in line with the outputs of the models included in the analysis.

3.2 Model

The link between network connectivity parameters and urban performance indicators in second-tier cities will be examined through multiple regression analysis. The regression model will be used to determine which particular connectivity characteristics have the most impact on the performance of cities. Since the parameter that this study focuses on is the network connectivity parameters, two models have been obtained that also confirms the hypothesis that it has a greater effect on secondary city performance than size and proximity parameters.

In order to support the hypothesis of the study, two different models were created, and the difference between these models is that the scale of the distance parameter to the primary cities is expanded and the distance to the 2nd closest primary city parameter is included in the second model. In the first model, the distance from the secondary cities to the nearest city between the Istanbul-Ankara-Izmir trio (3.1), and in the second model, the distance from the secondary cities to the 2nd closest primary city (Istanbul-Ankara-Izmir-Kocaeli-Antalya-Bursa-Eskişehir-Muğla-Tekirdağ) is included in addition to this parameter (3.2). These provinces, which are included in the models as first-tier cities, have been accepted with reference to the development ranking, which is the result of the "Socio-economic Development Index of Provinces-2017" study. The development ranking, which is the output of SEGE-2017, also represents the secondary city performance, which is the dependent variable of both two models.

The first model will be of the form:

$$\text{Second-tier City Performance} = \beta_0 + \beta_1 \text{(Urbanized Area Population)} + \beta_2 \text{(Distance to } 1^{st} \text{ First-tier City)} + \beta_3 \text{(Total Export)} + \beta_4 \text{(Total Cargo)} + \varepsilon \tag{3.1}$$

The second model will be of the form:

$$\text{Second-tier City Performance} = \beta_0 + \beta_1 \text{ (Urbanized Area Population)} + \beta_2 \text{ (Distance to 1}^{st}\text{ First-tier City)} + \beta_3 \text{ (Distance to 2}^{nd}\text{ First-tier City)} + \beta_4 \text{ (Total Export)} + \beta_5 \text{ (Total Cargo)} + \varepsilon \tag{3.2}$$

Where:

- Second-tier City Performance represents the dependent variable (SEGE17-Socio-economic Development Index | Secondary Cities).
- Network Connectivity, Size and Proximity correspond to the independent variable that explains the borrowed performance between second-tier cities and metropolitan cities.
- β_0 is the intercept of the regression equation.
- β_1 is the coefficient, representing the change in urban performance associated with a one-unit change in size of cities, urbanized area population.
- β_2 is the coefficient, representing the change in urban performance associated with a one-unit change in distances (km) to first-tier cities.
- β_3 (Total Export) + β_4 (Total Cargo) representing the change in urban performance associated with a one-unit change in network connectivity (total exports and total cargo).
- ε is the error term, accounting for unexplained variation in urban performance.

3.3 Data and Variables

This study's research design is quantitative. The purpose of the study is to investigate the extent of the impact area of network connectivity, on the urban performance in Turkey's second-tier cities. More precisely, the question to be investigated is whether the parameter that most affects secondary city performance is size, i.e. the population of the urbanized area, the proximity distances to the primary cities in terms of kilometers, or the parameters of network connectivity. When we look at the previous empirical studies from different country cases, it has been seen that the size, that is, the population parameter, plays a significant determining role, but in recent studies in the literature, there have been discussions about whether the effect of network connectivity on performance is more than size. For the discussions of areas overshadowed by agglomeration and areas borrowing performance, it has been argued that proximity to primary cities has a leading effect on secondary city performance, based on agglomeration economies. These agglomeration shadow-borrowed size concepts have been extended to the concept of "borrowed performance" and “borrowed function”, and studies have been conducted in the literature on whether network connectivity is strong enough even compared to size and proximity.

In this context, the study will try to model the extent to which network connectivity, size and distances between the 3 primary cities in Turkey, Istanbul-Ankara-Izmir and the remaining 78 provinces, affect the secondary city performance. To determine the precise network connection metrics that are highly correlated with urban performance, the research strategy entails gathering data from various sources and doing multiple regression analyses.

3.3.1 Sampling

A sample area covering 81 provinces of Turkey will be used to measure the network connectivity between primary and secondary cities and the effect of the strength of this connection on the urban performance of secondary cities. The network analyses made by YERSIS will be a guide and reference in determining the primary and secondary cities in this study, and measuring the situation of secondary cities being overshadowed by the agglomeration or borrowing performance from the primary city. City stratification and integrated network relations scores in the network analysis of YERSIS will be helpful in evaluating the results of the regression analysis.

3.3.2 Variables

The studies in the literature have measured network connectivity through various parameters such as employment density, transport costs, accessibility, and foreign direct investment. This will involve data on transportation nodes, telecommunications infrastructure, and other relevant connectivity measures that capture the relationship between second-tier cities and metropolitan areas. Urban performance parameters included GDP per capita, productivity, and employment growth. The concepts of borrowed size and agglomeration shadow, which are forms of network externalities, were measured through regression analysis and economic modeling. Agglomeration shadow was measured through model simulations based on parameters such as transport costs, agglomeration economies, and production costs, while the borrowed size was measured through regression analysis of accessibility, density, and diversity.

3.3.2.1 Dependent variable

Development is a social, economic, political and environmental process, and it is not possible to call a country developed or underdeveloped only by indicators of economic growth. The long lifespan of countries with strong social services (Sri Lanka, China) even though their GDP-GNP ratios are low supports this argument. In this case, although these criteria are not the main parameters of development, they are necessary to measure the economic growth of a country and provide information about the economic dimension of development. Human Development Index prepared by United Nations Development Programme, was established to highlight that a country's development should be evaluated primarily on the basis of its people and their abilities, not just its economic activity and numerical equivalent of economic growth. The Human Development Index consists of the elements of longevity, knowledge/education and a good standard of living, and the Gender Inequality Index addresses aspects of gender-based disadvantages such as reproductive health, women's competence and female labor force, while incorporating gender equality into the parameters of well-being. Both indexes include a clean, healthy and sustainable environment in these parameters.

For the Urban Performance dependent variable to be measured, the Socio-Economic Development Ranking Research of Provinces and Regions SEGE 2017 (Socio-Economic Development Index prepared with 2014 data) prepared by the General Directorate of Development Agencies was used. The SEGE-2017 study was concluded with 52 variables under the headings of demography, employment, education, health, competitive and innovative capacity, financial, accessibility and quality of life, and the relative rankings and levels of the provinces were determined.

Before deciding to use the SEGE-2017 ranking as the dependent variable, it was aimed to prepare a more specific performance/livability index with current data, including ecological, social, cultural and infrastructural parameters, since an index that predominantly includes economic parameters would not be a real livability indicator.

However, since preparing a new index would exceed the purpose and scope of this study, not all of the data could be accessed, and the index to be made could not be as comprehensive as SEGE-17, it was decided that it was more reliable and appropriate to use the SEGE ranking. However, in order to make a comparison, a model trial was conducted in which gdp per capita (log) was included as a dependent variable.

Urban performance parameters, which have been most used in empirical studies on the relevant subject in the literature, are listed below.

Parameters to measure urban performance as the dependent variable:

- Access to basic services such as healthcare, education, and public transportation
- Sustainability and environmental quality, measured by air and water pollution levels, energy efficiency, resource management
- Economic indicators, presence and diversity of economic activities, measured by the number and types of businesses and industries operating in the cities and their surrounding areas, GDP, employment rates, income levels, business growth, and investment
- Level of economic and social inclusion, measured by income distribution, poverty rates, and social mobility
- Innovation and creativity, measured by presence of research institutions, startups, and creative industries
- Cultural and social amenities, measured by the availability of cultural institutions, recreational facilities, and public spaces

In the preparation phase of the SEGE study, the studies of international organizations were scanned. In this context, indexing studies prepared by OECD for the purpose of comparing regions were also taken into consideration. In the composite index study created by OECD for 362 regions in member countries (A Composite Index for Monitoring Regional Development in OECD Regions), 51 variables were determined under three headings, but due to data constraints, the index was created using 22 variables. There are 10 variables under competitiveness, which is the first of these three headings. Issues such as income, employment, demographics and number of patents are discussed under competitiveness. The second sub-heading is social inclusion. There are eight variables under this heading. It is seen that issues such as individuals' access to education, health and transportation opportunities and the employment market are at the forefront within social inclusion. Under the third sub-heading, environmental sustainability, four variables related to air pollution and private vehicle use were used. These variables were also taken into consideration in the SEGE-2017 study.

In addition to the mentioned topics, one of the issues that the OECD has recently emphasized is the measurement of individual welfare levels. Development of a variable set related to poverty at the regional level, the importance of environmental variables in the quality of life, the benefits provided by agglomeration economies in metropolitan cities and the inclusion of negative elements such as social exclusion, environmental pollution and traffic in the analyzes are among the discussion topics of the OECD (OECD, 2011b). In this context, a separate group of variables was determined under the title of "Quality of Life Variables" in the SEGE-2017 study.

According to the index values obtained, the development levels of the provinces in Turkey are determined as six levels. Within the scope of this study, levels were determined based on the natural diffractions of the index values. As a result of the Strong Principal Components Analysis conducted with 52 variables selected by establishing a balance between regional capacity and potential and individual welfare, index values ranging from 4.051 (Istanbul) to -1.788 (Şırnak) were obtained. As a result of the analysis, 9 provinces with index values above 1 (Istanbul, Ankara, Izmir, Kocaeli Antalya, Bursa, Eskişehir, Muğla and Tekirdağ) are in the first development stage. These nine provinces have the highest values in a significant portion of the variables used in the study; It stands out as the industry, production, export, education and tourism centers of our country. Istanbul, Ankara and Izmir, which are in the top three ranks in the SEGE 2017 ranking, are among the top 3 cities with the highest values in 27, 21 and 14 of the 52 variables used in the study, respectively.

The first and second development levels, which include the most developed provinces, include provinces from the Marmara, Central Anatolia, Aegean and Mediterranean Regions. Karabük province from the Black Sea Region is among the provinces in the second development stage. In the third, fourth and fifth development levels, which represent medium development, there are provinces mainly from the Central Anatolia, Black Sea, Mediterranean and Eastern Anatolia Regions, but the provinces of Uşak, Kütahya and Afyonkarahisar in the Central Aegean are also included in this group. The provinces in the Eastern and Southeastern Anatolia Region are mostly in the sixth development stage.

3.3.2.2 Independent variables

While determining the independent variables affecting the dependent variable, which is the secondary city performance, data on size, that is, the population of secondary cities, and proximity, that is, the distance in kilometers of secondary cities to primary cities, were collected. A search for data was undertaken in order to include in the model the network connectivity parameters, that is, the network externalities that enable cities to work with each other as a backbone beyond administrative borders (whether they border each other or not), benefiting each other, but also causing disadvantages for some other cities. Network connectivity parameters, which have been most used in empirical studies on the relevant subject in the literature, are listed below.

Parameters to measure network connectivity as the independent variable:

- Number of transportation nodes (such as airports, ports, train stations, and highways) connecting the cities and their surrounding areas
- Amount and frequency of passenger and freight transport between the cities and their surrounding areas
- Level of telecommunication infrastructure and internet connectivity in the cities and their surrounding areas
- Level of integration with regional and global economic networks, measured by foreign direct investment, trade flows, and business connections
- Presence and quality of higher education institutions and research centers in the cities and their surrounding areas

In this regard, the independent variables were determined as the population of the urbanized area for the size parameter, the length of the distances of the cities to each other (kilometers) for the proximity parameter, and total exports according to economic activities (US dollars) and the total number of cargo carried on domestic and international lines for the network connectivity parameters.

Distance to first-tier cities

For proximity, one of the independent variables, distances to SEGE-2017 first level provinces were examined. Within the scope of this study, the distance of each city to its closest city from the Istanbul-Ankara-İzmir trio and in addition the distance data to the 2nd closest city among the 9 first-tier cities (İstanbul-Ankara-İzmir-Kocaeli-Antalya-Bursa-Eskişehir-Muğla-Tekirdağ) were included in the models. The first model was analyzed only with the proximity parameter to the first 3 metropolitan cities, and the second model was analyzed with the distance parameter to the first (Istanbul-Ankara-Izmir) and second (Istanbul-Ankara-Izmir-Kocaeli-Antalya-Bursa-Eskişehir-Muğla-Tekirdağ) metropolitan cities (Figure 3.2).

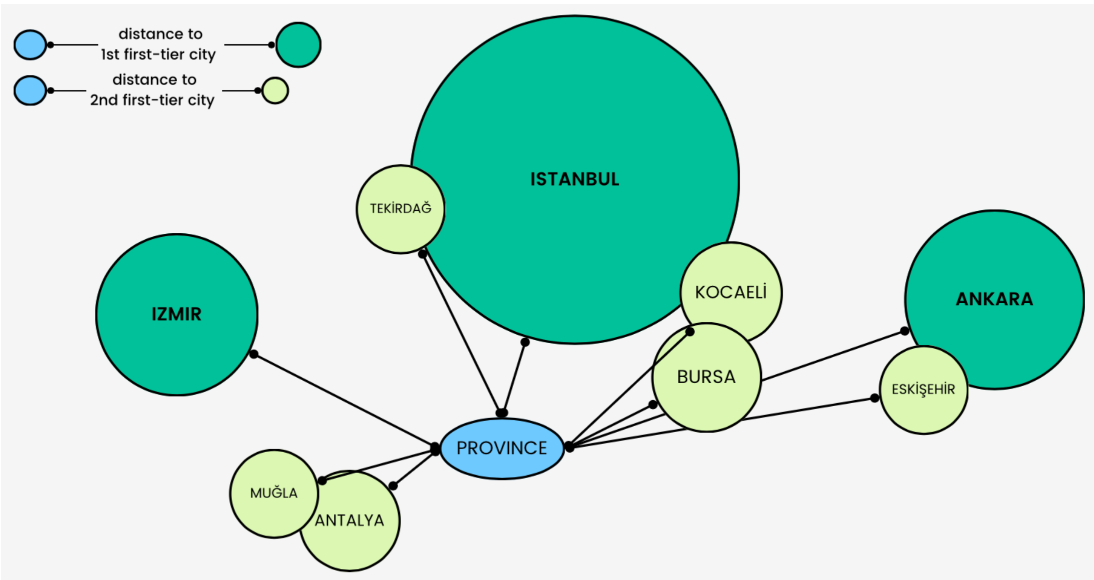

Figure 3.2 : Distance to first-tier cities (from any province).

Istanbul continues to be the most developed city of the country in this period. According to 2014 data, 18.5 percent of the country's population lives in Istanbul and 52 percent of the country's exports are carried out from Istanbul. Approximately 36 percent of manufacturing industry workplaces and half of the parcels on which production is carried out in OIZs across the country are located in Istanbul. In this respect, Istanbul continues to be the industrial and production center of Turkey. On the other hand, Istanbul also stands out as the financial center of Turkey. 42.5 percent of total bank loans and approximately 40 percent of total savings deposits in Turkey are located in Istanbul. Again, 46.8 percent of tax revenues in Turkey are collected from Istanbul. Ankara, which ranked second in the SEGE-2017 study, stands out especially with its qualified workforce potential. In terms of the rate of college or faculty graduates among the population aged 22 and over, Ankara ranks first among 81 provinces with a rate of 22.7 percent, while this rate is 14.9 percent across the country. Similarly, in the ratio of the population with a master's degree or doctorate to the population aged 30 and over, only 1.8 out of every 100 people in Turkey have a master's degree or doctorate, while in Ankara this ratio is 4.4. Izmir ranks high in the number of manufacturing industry workplaces, OIZ and CSR variables. Izmir ranks first in this variable, with 5.5 percent of the total number of CSR workplaces across the country. While approximately 7 percent of the total manufacturing industry workplaces in Turkey are located in Izmir; Izmir ranks third in terms of the ratio of total parcels produced in OIZs in Turkey (2.5 percent).

While Kocaeli ranks first in the central budget income per capita variable, it also ranks second in the per capita export variable. It is also among the best provinces in terms of variables in the accessibility dimension. Antalya emerges as the province with the best value in Turkey in terms of tourism, agriculture, number of foreign capital companies per capita and literate female ratio. While Bursa has very high values in the variables in the competitiveness dimension; Eskişehir stands out in education and environmental variables. While Muğla ranks first in the number of pharmacies per capita and residential electricity consumption variables, it also has high values in the tourism variable and financial variables. Bursa and Kocaeli are in an important position in our country, especially in terms of export capacity. 5.9 percent of Türkiye's total exports are made from Bursa and 5.7 percent from Kocaeli. In terms of export amount per capita, Kocaeli ranks second with $5,164 and Bursa ranks fourth with $3,339. Antalya and Muğla provinces have become international centers of attraction due to their developed tourism opportunities. Antalya and Muğla provinces are in the first two ranks among 81 provinces in terms of the number of tourism investment-operation and municipality-certified beds. One of the leading reasons why Antalya and Eskişehir are among the first-tier provinces is their high level of development in the field of education. According to 2014 data, Antalya ranks first and Eskişehir ranks seventh in terms of the rate of literate women (97.6 percent). In terms of the ratio of the population with college or faculty degrees to the population aged 22 and over, Eskişehir (18.2 percent) ranks second after Ankara (22.7 percent). Tekirdağ ranks first in the ratio of manufacturing industry employment to insured employment and second in the variable of industrial electricity consumption per capita. While the Turkey average in the ratio of manufacturing industry employment to insured employment is 27.1 percent, this rate is 55.9 percent in Tekirdağ.

Size

For the size parameter, the total of female and male population data in the densely populated areas and intermediate-density populated areas categories within the urban-rural population classification for 2022 was used, and the urbanized area population (UAP) was specified as one of the independent variables in the model. In the first model trials, the 10-year median of the population size normalized data of provincial and district centers covering the years 2013-2022 (Regional Statistics, TÜİK) was used, but later it was decided that the urbanized area population data (TÜİK, 2022) would be more suitable for the scope of the study and model.

The relationship of this variable with the model and research design is due to its importance being emphasized throughout the relevant literature. However, recent studies have shown that there are factors that may go beyond the importance of size. The model designed in line with the hypothesis of this study will try to measure whether the parameters that have overcome the importance of size are also valid for secondary cities in Turkey by comparing them with network connectivity and proximity.

Network connectivity

In order to observe the strength of the effect of network connectivity on secondary city performance and whether it makes a difference beyond proximity and size parameters, the parameters included in the model were determined as total exports and total number of cargo. While using the total export amount (1000 USD Dollars) data according to economic activities and the total number of cargo carried on domestic and international lines data for the years 2013-2022, these data were normalized and their medians were entered as input into multiple regression.

Since Foreign Direct Investment (FDI) data, a parameter frequently included in the models in relevant studies in the literature, cannot be accessed, employment data provided by investment incentives in cities was used in model trials. However, it was seen from the correlation table and the coefficient values in the model's output that employment provided by investment incentives did not have any effect on urban performance. Therefore, investment incentive-employment data was not included in the models, and the inaccessibility of FDI data remained one of the data limitations of the study. The contribution of city-level FDI data to this study would have been useful to evaluate the network connectivity and performance of the Istanbul-Ankara-Izmir trio, and perhaps even other primary cities, not only regionally and nationally, but also internationally. As another network connectivity parameter, mobile signal data and mobile broadband internet subscriber number data were included in the model experiments separately, but as seen in the output of the models, their statistical significance remained weak because of the multicollinearity problem.

3.3.3 Data collection

The data for this research will be gathered at the provincial level in Turkey. Information on network connections and urban performance metrics will be collected through various sources. The primary sources of the data utilized in this study include publicly available databases, statistical reports, governmental publications, relevant academic journals, and official government statistics (Table 3.1). To ensure data accuracy and comprehensiveness, various sources of data will be used.

3.3.4 Limitations of the study/further research

Throughout the study process, ethical issues will be taken into account. Data will be gathered from publicly available sources, ensuring anonymity and confidentiality. The study will abide by all applicable ethical standards and laws, protecting the rights and privacy of individuals and organizations taking part in the data-collecting process. This study acknowledges several limitations even as it seeks to provide insightful information about the network connectivity and urban performance of Turkey's second-tier cities. Data accessibility, the scope of variables, and the scope of data level are a few potential restrictions. The analysis is based on province-level aggregate data, which might conceal variations across provinces.

Table 3.1 : Data sources.

Variables		Unit of the Parameter	Data Time Period	Source of Data
Dependent Variable	SEGE 2017 ranking secondary city performance (urban performance index)	index value (-1.788,+4.051)	2014	T.R. Ministry of Industry and Technology
Independent Variables	distance to first-tier cities (proximity)	km	-	Courtesy of Arda Tuncer (Unpublished Data)
	urbanized area population (size)	total number of people living in medium-dense and densely urbanized areas	2022	Turkish Statistical Institute
	total exports (network connectivity)	1000 USD normalized by the population of the province	2013-2022 (median)	Regional Statistics, Turkish Statistical Institute
	total cargo (network connectivity)	normalized by the population of the province	2013-2022 (median)	Regional Statistics, Turkish Statistical Institute

Within the scope of the study, model experiments were first conducted to measure the relationship between trade, transportation, mobile signal and export data from YERSİS Network Analysis data and secondary city performance. However, since these parameters, which were selected as network connectivity parameters, showed very high correlations among themselves in descriptive analyses, they were not deemed suitable for inclusion in the multiple regression analysis and were not included in the study. YERSIS Network Analysis data partially confirmed the hypothesis of the study by showing a high correlation with the dependent variable, which is the secondary city performance. Although the data seemed very suitable for this study at first, the problem of multicollinearity between independent variables reduced statistical significance, so different data was sought for network connectivity parameters. The suitability of the collected data for multiple regression was tested and then model trials were started again.

Another data limitation of the study is the inability to access Foreign Direct Investment data, which is frequently encountered in studies on the subject in the literature. Institutions were contacted for Foreign Direct Investment data on a provincial basis, but these data were not shared for inclusion in the research due to reasons such as confidentiality and data protection. A much more extended analysis could have been made with Foreign Direct Investment data. This parameter, chosen as one of the parameters to be used to measure network connectivity, could serve to filter domestic and foreign investments between provinces. Additionally, with this data, we could talk about network connectivity on a regional, national and international scale. Accessing this data, especially for a global representative city like Istanbul, would be useful in interpreting the performance of other metropolitan cities and secondary cities. In future studies, on the basis of national and international firms, it can be investigated how the relations of these companies affect the Istanbul-Ankara-Izmir trio axis (and Turkey). Since the data used in this study are at the provincial level, it may be possible to evaluate different results with firm-level data.

One potential gap in the literature for further research on this topic is the role of social and cultural factors in shaping the relationship between Istanbul's agglomeration shadow and borrowed size and the economic development of its neighboring cities. While much of the existing literature focuses on the economic and spatial factors that contribute to the growth of urban areas, there is relatively little research on how social and cultural factors shape the dynamics of regional development. For example, research could explore how social and cultural factors influence the preferences of individuals and businesses for locating in certain areas, and how these preferences interact with the economic and spatial factors that drive agglomeration and regional development. Research could also examine how social and cultural factors influence the policies and strategies that are implemented to promote balanced regional development, and how these policies and strategies may need to be tailored to the specific social and cultural context of different regions. Exploring the role of social and cultural factors in shaping the dynamics of regional development would not only contribute to a more comprehensive understanding of the factors that influence economic growth and development, but could also help to identify new and innovative approaches to regional planning and policy-making that take into account the unique social and cultural context of different regions.

3.4 Data Analysis

Multiple Regression Analysis used in this study's data analysis to identify the precise network connection factors that have the strongest correlation with urban performance. To investigate the link between the dependent variable (urban performance indicators) and the independent variables (network connectivity parameters, size, proximity distances), multiple regression models designed. The study employ ordinary least squares (OLS) regression analysis to estimate the coefficients of the independent variables and test their significance.

3.4.1 Descriptive Statistics

The main characteristics of the data will be outlined by descriptive statistics, which will provide an overview of the distribution of the variables and highlight any outliers or missing data. The correlation and distribution tables of different models tried until the most appropriate model is reached within the scope of the study are shown below. Different models were designed due to reasons such as high correlation between independent variables and the inability of variables with low correlation with the dependent variable to form a statistically significant model.

3.4.1.1 Model 1

When the correlation table prepared for Model 1, in which 4 independent variables were included to investigate the effect on the dependent variable (Table 3.2), was examined, it was seen that the parameter with the highest correlation with the secondary city performance, which is the dependent variable, was the "distance to the first primary-city" with a coefficient of - 0.718 (p-value = 0.000). The high correlation ranking was followed by the urbanized area population with a coefficient of 0.367 (p-value = 0.000), which is the size parameter, and total export, that is, the network connectivity parameter, with a coefficient of 0.308 (p-value = 0.006), followed. The lowest correlation with the dependent variable was exhibited by the total number of loads carried on domestic and international lines, which is the network connectivity parameter, with a coefficient of 0.233 (p-value = 0.040). There is no variable that can cause multicollinearity problem among the independent variables, and the correlation between them is within the appropriate limit (Table 3.3). Therefore, linearity tests prepared before multiple regression for the variables included in the first model were deemed appropriate and inputs were provided to the analysis.

Table 3.2 : Model 1 correlation coefficients.

Correlation Coefficients (Pairwise deletion)					
R	distance to 1st first-tier city	urbanized area population	total export	total cargo	secondary city performance
distance to 1st first-tier city	1,0000				
R Std Err					
t					
p-value (2-tailed)					
N					
urbanized area population	-0,1662	1,0000			
R Std Err	0,0128				
t	-1,4689				
p-value (2-tailed)	0,1460				
N	78				
total export	-0,2799	0,4810	1,0000		
R Std Err	0,0121	0,0101			
t	-2,5414	4,7825			
p-value (2-tailed)	0,0131	8,3010E-6			
N	78	78			
total cargo	0,0825	0,3091	-0,1016	1,0000	
R Std Err	0,0131	0,0119	0,0130		
t	0,7221	2,8336	-0,8906		
p-value (2-tailed)	0,4725	0,0059	0,3759		
N	78	78	78		
secondary city performance	-0,7183	0,3677	0,3080	0,2331	1,0000
R Std Err	0,0064	0,0114	0,0119	0,0124	
t	-9,0011	3,4474	2,8225	2,0896	
p-value (2-tailed)	0,0000	0,0009	0,0061	0,0400	
N	78	78	78	78	

Correlations in bold are significant at the 5% level (2-tailed).

Table 3.3 : Model 1 variable to variable r and p-value.

R			
VAR vs. VAR	*R*	*N*	*p-value*
secondary city performance vs. distance to 1st first-tier city	-0,7183	78	0,0000
total export vs. urbanized area population	0,4810	78	8,3010E-6
secondary city performance vs. urbanized area population	0,3677	78	0,0009
total cargo vs. urbanized area population	0,3091	78	0,0059
secondary city performance vs. total export	0,3080	78	0,0061
total export vs. distance to 1st first-tier city	-0,2799	78	0,0131
secondary city performance vs. total cargo	0,2331	78	0,0400
urbanized area population vs. distance to 1st first-tier city	-0,1662	78	0,1460
total cargo vs. total export	-0,1016	78	0,3759
total cargo vs. distance to 1st first-tier city	0,0825	78	0,4725

3.4.1.2 Model 2

When the correlation table of model 2 with 5 independent variables, which was included in the model to measure its effect on the performance of the secondary city, which is the dependent variable, was examined, it was seen that the variables with the highest correlation with the dependent variable were "distance to 1st first-tier city" with a coefficient of -0.754 (p-value = 0.000) and "distance to 2nd first-tier city" with a coefficient of -0.677 (p-value = < 0.000). Following this, the correlation coefficient of the network parameter, which is the total export, with the secondary city performance is 0.112 (p-value = 0.348). The correlation between the total number of freight carried on domestic and international lines and the secondary city performance is -0.265 (p-value = 0.024), and the variable that is least correlated with the dependent variable is the population of the urbanized area with a coefficient of 0.036 (p-value = 0.758). In the first model, the correlation between the secondary city performance, which is the dependent variable, and the variable of the total number of loads carried on domestic and international lines was positive and had a coefficient of 0.233, while in the second model, it was negatively correlated with a coefficient of -0.265 (Table 3.2 and Table 3.4). The reason for this is that in the first model, the data of Istanbul-

Ankara-Izmir provinces were extracted and analyzed with 78/81 provincial data, and in the second model, the data of Istanbul-Ankara-Izmir-Kocaeli-Antalya-Bursa-Eskişehir-Muğla-Tekirdağ provinces were extracted and analyzed with 73/81 provincial data. It is common to see a high correlation between the proximity parameters "distance to 1st first-tier city" and "distance to 2nd first-tier city" with a coefficient of 0.952. Apart from this, no correlation was observed with height that could cause multicollinearity problem by disrupting linearity among other variables (Table 3.5).

Table 3.4 : Model 2 correlation coefficients.

Correlation Coefficients (Pairwise deletion)						
R	distance to 1st first-tier city	distance to 2nd first-tier city	urbanized area population	total export	total cargo	secondary city performance
distance to 1st first-tier city	1,0000					
R Std Err						
t						
p-value (2-tailed)						
N						
distance to 2nd first-tier city	0,9527	1,0000				
R Std Err	0,0013					
t	26,2228					
p-value (2-tailed)	0,0000					
N	72					
urbanized area population	-0,0545	-0,0866	1,0000			
R Std Err	0,0142	0,0142				
t	-0,4569	-0,7271				
p-value (2-tailed)	0,6492	0,4696				
N	72	72				
total export	-0,2053	-0,2377	0,3459	1,0000		
R Std Err	0,0137	0,0135	0,0126			
t	-1,7547	-2,0471	3,0842			
p-value (2-tailed)	0,0837	0,0444	0,0029			
N	72	72	72			
total cargo	0,3805	0,4156	0,1660	-0,0016	1,0000	
R Std Err	0,0122	0,0118	0,0139	0,0143		
t	3,4421	3,8229	1,4087	-0,0137		
p-value (2-tailed)	0,0010	0,0003	0,1634	0,9891		
N	72	72	72	72		
secondary city performance	-0,7547	-0,6773	0,0369	0,1122	-0,2650	1,0000
R Std Err	0,0061	0,0077	0,0143	0,0141	0,0133	
t	-9,6235	-7,7015	0,3093	0,9448	-2,2994	
p-value (2-tailed)	0,0000	6,4748E-11	0,7580	0,3480	0,0245	
N	72	72	72	72	72	

Correlations in bold are significant at the 5% level (2-tailed).

Table 3.5 : Model 2 variable to variable r and p-value.

R			
VAR vs. VAR	*R*	*N*	*p-value*
distance to 2nd first-tier city vs. distance to 1st first-tier city	0,9527	72	0,0000
secondary city performance vs. distance to 1st first-tier city	-0,7547	72	0,0000
secondary city performance vs. distance to 2nd first-tier city	-0,6773	72	6,4748E-11
total cargo vs. distance to 2nd first-tier city	0,4156	72	0,0003
total cargo vs. distance to 1st first-tier city	0,3805	72	0,0010
total export vs. urbanized area population	0,3459	72	0,0029
secondary city performance vs. total cargo	-0,2650	72	0,0245
total export vs. distance to 2nd first-tier city	-0,2377	72	0,0444
total export vs. distance to 1st first-tier city	-0,2053	72	0,0837
total cargo vs. urbanized area population	0,1660	72	0,1634
secondary city performance vs. total export	0,1122	72	0,3480
urbanized area population vs. distance to 2nd first-tier city	-0,0866	72	0,4696
urbanized area population vs. distance to 1st first-tier city	-0,0545	72	0,6492
secondary city performance vs. urbanized area population	0,0369	72	0,7580
total cargo vs. total export	-0,0016	72	0,9891

3.4.3 Multiple regression analysis

Model 1: distance to 1st first-tier city (top-3)

For model 1 with 4 independent variables (distance to 1st first-tier city, urbanized area population, total export, total cargo), analysis was made with 2 different dependent variables. Since the hypothesis of the thesis is to measure the parameters affecting secondary city performance, the model was also tested with gdp per capita, which is frequently used in the relevant literature but is not included in the main model because it is limited to being only an economic criterion (and is also one of the 52 parameters in the secondary city performance index). The regression analysis for the secondary city performance dependent variable yielded a significant model summary: F = 31.43, p-value < .001, Adjusted R Square = .61, R Square Change = .63, Durbin-Watson = 1.57 (Table 3.6 and Table 3.7). The regression analysis for gdp per capita (log) dependent variable also yielded a significant model summary: F = 30.91, p-value < .001, Adjusted R Square = .60, R Square Change = .62, Durbin-Watson = 1.83 (Table 3.8 and Table 3.9).

Table 3.6 : Model 1 ANOVA statistics (secondary city performance index dependent variable).

Dependent variable	secondary city performance				
Independent variables	total export, total cargo, urbanized area population, distance to 1st first-tier city				
N	78				
	ANOVA				
	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	4	24.308.282,32	6.077.070,58	31,439	0
Residual	73	14.110.704,80	193.297,33		
Total	77	38.418.987,12			

Table 3.7 : Model 1 regression statistics (secondary city performance index dependent variable).

Regression Statistics					
R	0,7954	*R-Squared*	0,6327	*Adjusted R-Squared*	0,6126
MSE	193.297,3260	*S*	439,6559	*MAPE*	93.666,8527
Durbin-Watson (DW)	1,5739	*Log likelihood*		-582,8009	
Akaike inf. criterion (AIC)	15,0718	*AICc*		15,0788	
Schwarz criterion (BIC)	15,2229	*Hannan-Quinn criterion (HQC)*		15,1323	
PRESS	16.647.946,7344	*PRESS RMSE*	461,9905	*Predicted R-Squared*	0,5667

Table 3.8 : Model 1 ANOVA statistics (gdp per capita dependent variable).

Dependent variable	gdp per capita log			
Independent variables	distance to 1st first-tier city, urbanized area population, total export, total cargo			
N	78			
	ANOVA			
	SS	*MS*	*F*	*p-value*
Regression	857.935,7670	214.483,9418	30,9113	0,0000
Residual	506.524,3484	6.938,6897		
Total	1.364.460,1154			

Table 3.9 : Model 1 regression statistics (gdp per capita dependent variable).

Regression Statistics					
R	0,7930	*R-Squared*	0,6288	*Adjusted R-Squared*	0,6084
MSE	6.938,6897	*S*	83,2988	*MAPE*	1,3660
Durbin-Watson (DW)	1,8321	*Log likelihood*		-453,0433	
Akaike inf. criterion (AIC)	11,7447	*AICc*		11,7517	
Schwarz criterion (BIC)	11,8958	*Hannan-Quinn criterion (HQC)*		11,8052	
PRESS	569.102,9024	*PRESS RMSE*	85,4177	*Predicted R-Squared*	0,5829

The variable with the highest coefficient on the dependent variable was the distance to 1st first-tier city which was negatively correlated with secondary city performance (Beta = -.696, t = -9.38, p-value = .000). This was an expected result in terms of Turkey's provinces, being located near large cities is mostly advantagous. This suggests that as the distance (km) to first-tier cities increases, the urban performance of secondary cities tends to decrease. In the analysis results, the second parameter with the highest standardized beta coefficient is the number of cargo transported by air, which shows a positive correlation with the performance of the secondary city (Table 3.10). The fact that the coefficient of this variable is the higher than the size variable's coefficient (urbanized area population), and the number of cargoes carried on domestic and international lines represents the national and international network connectivity also supports the hypothesis of the study (Beta = .255, t = 3.25, p-value = .001). As the coefficients table reveals that total exports, which is the other network connectivity parameter, had a positive influence on secondary city performance (Beta = .072, t = .83, p-value = .404). The size parameter, which is urbanized area population exhibited a positive effect on the performance of secondary cities (Beta = .138, t = 1.55, p-value = .124), indicating that cities with larger urbanized populations tend to perform better. However, since the p-value =.124 value of the urbanized area population (UAP), and the p-value = .404 value of total export parameter is exceeding the limit of statistical significance (.05). The values of the variance inflation factors (VIF) suggest no evidence of multicollinearity in the dataset. Correlation analysis indicates that distance to 1st first-tier cities exhibit the highest correlation (-0.71) with the dependent variable, urban performance. Furthermore, the table highlights that network connectivity parameters, particularly total cargo, significantly impact secondary city performance compared to size. The parameters that most affect secondary city performance are distance to 1st first-tier city, total cargo, urbanized area population, total export (Table 3.21). However, in the analysis made with the dependent variable gdp per capita, it was seen that this order was different and the size parameter had the lowest coefficient. The coefficient of the distance to 1st first-tier city parameter is the highest (Beta = -.673, t = - 9.03, p-value = .000), followed by total export (Beta = .299, t = 3.43, p-value = .001), total cargo (Beta = .179, t = 2.27, p-value = .025) and then urbanized area population (Beta = -.049, t = - .55, p-value = .580). Since the p-value of the urbanized area population (size) variable is exceeding the .05 limit, this variable's contribution to analysis is statistically insignificant (Table 3.11).

Table 3.10 : Model 1 coefficients (secondary city performance index dependent variable).

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*VIF*	*TOL*	*Beta*
Intercept	382,5711	110,6239	162,0980	603,0442	3,4583	0,0009			
distance to 1st first-tier city	-1,3551	0,1444	-1,6428	-1,0673	-9,3852	**0,0000**	1,0933	0,9146	**-0,6961**
urbanized area population	0,0002	0,0001	-4,6047E-5	0,0004	1,5548	**0,1243**	1,5715	0,6363	**0,1383**
total export	0,0466	0,0555	-0,0640	0,1571	0,8393	**0,4040**	1,4891	0,6715	**0,0727**
total cargo	8.459,7509	2.600,1560	3.277,6476	13.641,8543	3,2536	**0,0017**	1,2228	0,8178	**0,2552**

Table 3.11 : Model 1 coefficients (gdp per capita dependent variable).

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*VIF*	*TOL*	*Beta*
Intercept	4.543,0005	20,9592	4.501,2289	4.584,7722	216,7545	0,0000			
distance to 1st first-tier city	-0,2471	0,0274	-0,3016	-0,1926	-9,0337	**0,0000**	1,0933	0,9146	**-0,6736**
urbanized area population	-1,1057E-5	1,9908E-5	-5,0734E-5	2,8620E-5	-0,5554	**0,5803**	1,5715	0,6363	**-0,0497**
total export	0,0361	0,0105	0,0152	0,0571	3,4356	**0,0010**	1,4891	0,6715	**0,2990**
total cargo	1.122,0177	492,6349	140,1977	2.103,8377	2,2776	**0,0257**	1,2228	0,8178	**0,1796**

Model 2: distance to second first-tier city (top-9)

Another model designed to support the hypothesis of the study was prepared to measure the extent of the effect of distances to first-tier cities. Unlike the first model, in which the distance to the closest one of the first 3 primary cities (İstanbul-Ankara-İzmir) was included as input, the model is prepared with the distance (km length) to the closest one of the first 9 primary cities. In other words, the distance of secondary cities to the closest one among the first 9 cities in the primary city category, Istanbul-Ankara-İzmir-Kocaeli-Antalya-Bursa-Eskişehir-Muğla-Tekirdağ, according to the SEGE2017 ranking, is included. A model trial was conducted with the assumption that it would be more appropriate to take into account the distance to a larger number of first-tier cities for the performance of secondary cities in a country with a large and wide geography like Turkey (even though cities that are far from Istanbul are also affected by Istanbul). The second model, in which the effect of 2 proximity, 1 size and 2 network connectivity variables on the dependent variable, which is secondary city performance, was analyzed, showed statistically significant results: $F = 18.93$, p-value $< .001$, Adjusted R Square = .55, R Square Change = .58, Durbin-Watson = 1.57 (Table 3.12 and Table 3.13). Similarly, in the model where the dependent variable is gdp per capita (log), the analysis is statistically significant: $F = 20.26$, p-value $< .001$, Adjusted R Square = .57, R Square Change = .60 , Durbin-Watson = 1.75 (Table 3.14 and Table 3.15).

Table 3.12 : Model 2 ANOVA statistics (secondary city performance index dependent variable).

Dependent variable	secondary city performance				
Independent variables	distance to 1st first-tier city, distance to 2nd first-tier city, urbanized area population, total export, total cargo				
N	72				
	ANOVA				
	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	5	13.555.083,11	2.711.016,62	18,9476	1,2310E-11
Residual	66	9.443.262,43	143.079,73		
Total	71	22.998.345,55			

Table 3.13 : Model 2 regression statistics (secondary city performance index dependent variable).

Regression Statistics					
R	0,7677	*R-Squared*	0,5894	*Adjusted R-Squared*	0,5583
MSE	143.079,7339	*S*	378,2588	*MAPE*	115.048,3039
Durbin-Watson (DW)	1,5777	*Log likelihood*	-526,3928		
Akaike inf. criterion (AIC)	14,7887	*AICc*	14,8013		
Schwarz criterion (BIC)	14,9784	*Hannan-Quinn criterion (HQC)*	14,8642		
PRESS	11.355.431,8737	*PRESS RMSE*	397,1326	*Predicted R-Squared*	0,5063

Table 3.14 : Model 2 ANOVA statistics (gdp per capita dependent variable).

Dependent variable	gdp per capita log				
Independent variables	distance to 1st first-tier city, distance to 2nd first-tier city, urbanized area population, total export, total cargo				
N	72				
	ANOVA				
	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	5	602.697,25	120.539,45	20,2639	3,4032E-12
Residual	66	392.600,03	5.948,49		
Total	71	995.297,28			

Table 3.15 : Model 2 regression statistics (gdp per capita dependent variable).

Regression Statistics					
R	0,7782	*R-Squared*	0,6055	*Adjusted R-Squared*	0,5757
MSE	5.948,4853	*S*	77,1264	*MAPE*	1,2731
Durbin-Watson (DW)	1,7573	*Log likelihood*	-411,9033		
Akaike inf. criterion (AIC)	11,6084	*AICc*	11,6211		
Schwarz criterion (BIC)	11,7981	*Hannan-Quinn criterion (HQC)*	11,6840		
PRESS	457.277,3121	*PRESS RMSE*	79,6936	*Predicted R-Squared*	0,5406

The coefficient of the proximity parameters "distance to 1st first-tier city" (Beta = - 1.184, t = 4.52, p-value < .001) and "distance to 2nd first-tier city" (Beta = - .447, t = 1.66, p-value = .101) have the highest influence on secondary city performance, while the coefficient of the total cargo (Beta = - .004, t = - .04, p-value = .964) which is the network connectivity parameter has lowest. When the regression coefficients were examined (Table 3.16), it was seen that the variable with the highest coefficient after the distance variables (distance to 1st first-tier city, distance to 2nd first-tier city) was the variable of the total export (Beta = .032, t = 1.19, p-value = .706). Unlike the first model, results show that urbanized are population which is the size variable still effect the secondary city performance (Beta = .023, t = .26, p-value = .789). However, since the p-values of the other 4 independent variables (distance to 2nd first-tier city, urbanized area population, total export, total cargo) except for the distance to 1st first-tier cities parameter exceeded the .05 significance limit value, these parameters are not statistically significant in regression. On the other hand, distance to 2nd first-tier city (Beta = - .645, t = - 2.44, p-value = .017) and total export (Beta = .172, t = 2.03, p-value = .045) parameters gave statistically significant results in the analysis of the degree of effect on the dependent variable of gdp per capita (log). However, distance to 1st first-tier city (Beta = -.131, t = - .51, p-value = .609), urbanized area population (Beta = -.145, t = -1.72, p-value = .089) and total cargo (Beta = .120, t = 1.37, p-value = .175) exceeded the .05 significance limit (Table 3.17).

Table 3.16 : Model 2 coefficients (secondary city performance index dependent variable).

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*VIF*	*TOL*	*Beta*
Intercept	368,3475	101,2304	166,2345	570,4604	3,6387	0,0005			
distance to 1st first-tier city	-1,8527	0,4092	-2,6698	-1,0357	-4,5276	**2,5592E-5**	11,0084	0,0908	**-1,1849**
distance to 2nd first-tier city	0,5871	0,3535	-0,1188	1,2929	1,6606	**0,1015**	11,6708	0,0857	**0,4475**
urbanized area population	2,7659E-5	0,0001	-0,0002	0,0002	0,2675	**0,7899**	1,1917	0,8391	**0,0230**
total export	-0,0198	0,0524	-0,1245	0,0849	-0,3777	**0,7069**	1,1992	0,8339	**-0,0326**
total cargo	-273,7652	6.050,2485	-12.353,4761	11.805,9456	-0,0452	**0,9640**	1,2822	0,7799	**-0,0040**

Table 3.17 : Model 2 coefficients (gdp per capita dependent variable).

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*VIF*	*TOL*	*Beta*
Intercept	4.556,0688	20,6407	4.514,8583	4.597,2793	220,7320	0,0000			
distance to 1st first-tier city	-0,0428	0,0834	-0,2094	0,1238	-0,5126	**0,6099**	11,0084	0,0908	**-0,1315**
distance to 2nd first-tier city	-0,1762	0,0721	-0,3201	-0,0323	-2,4445	**0,0172**	11,6708	0,0857	**-0,6456**
urbanized area population	-3,6341E-5	2,1084E-5	-7,8435E-5	5,7542E-6	-1,7236	**0,0895**	1,1917	0,8391	**-0,1455**
total export	0,0218	0,0107	0,0005	0,0432	2,0392	**0,0454**	1,1992	0,8339	**0,1726**
total cargo	1.690,9974	1.233,6369	-772,0381	4.154,0329	1,3707	**0,1751**	1,2822	0,7799	**0,1200**

3.4.4 Interpreting results

Although the results of the analysis of the first model, which examines the effect of being close to Istanbul-Ankara-Izmir, having a large population and network relations on secondary city performance, are statistically significant, the variables that are significant for regression are only distance to 1st first-tier city and total cargo variables. Therefore, the setup of the first model supports the hypothesis of the study with the fact that distance and network are more important and meaningful than size in the context of the effect on the dependent variable. In the model experiment conducted with the same independent variables, but in which the dependent variable was gdp per capita (log), it was seen that only distance to 1st first-tier city and total export, that is, distance and network parameters, gave statistically significant results. In other words, it can be said that having network flows with Istanbul-Ankara-Izmir, and being near to them are likely to enable secondary cities to borrow performance beyond their size.

On the other hand, in the 2nd model, which included distance to Istanbul-Ankara-Izmir (distance to 1st first-tier city) and Istanbul-Ankara-Izmir-Kocaeli-Eskişehir-Bursa-Tekirdağ-Muğla-Antalya (distance to 2nd first-tier city), it was seen that the only variable that gave statistically significant results for the secondary city performance dependent variable was distance to 1st first-tier city. In the gdp per capita (log) dependent variable model made with the same independent variables, distance to 2nd first-tier city and total export variables are statistically significant in the analysis. In this context, the distance of secondary cities to 2nd first-tier cities and total export, that is, network relations, are important for GDP per capita.

The advantage of being close to primary cities among secondary cities has been emphasized a lot in the literature, but recent studies have shown that the performance of secondary cities located on the periphery of a primary city can be very different from each other. Considering two secondary cities on the periphery of the same primary city, it was found that the one that was closer to the primary city was able to perform better than the other while the population size was less than the other.

In the case of Turkey, Konya and Eskişehir, which are located on the periphery of Ankara, are a good example of this situation, and although Eskişehir has a smaller population compared to Konya, it is advantageous to be closer to Ankara than Konya (Ankara-Konya 271km, Ankara-Eskişehir 234km, Eskişehir Urbanized Area

Population Size: 792,194 people, Konya Urbanized Area Population Size: 1,825,560 people). On the other hand, Yozgat, which is closer to Ankara than Konya, performed lower than both Konya and Eskişehir due to being a secondary city with a smaller population (Ankara-Yozgat 209km, Yozgat Urbanized Area Population Size: 248836 people). In other words, it is not only possible for secondary cities to borrow performance by being close, but also the population of urbanized areas may need to be large. In order to benefit from this pool of "agglomeration advantages" provided by primary cities to secondary cities, this competitive environment also requires strong network connections. Beyond the fact that Eskişehir is closer to Ankara than Konya and has a smaller population than Konya, the reason why Eskişehir is at the top of the SEGE-2017 performance ranking is the strong network connectivity of Eskişehir and the functions it can exhibit accordingly.

4. CONCLUSION

It has become evident in recent studies that it is possible to complete the missing connection between today's urban dynamics and agglomeration theory – the points that the new economic geography is insufficient to explain – with a network perspective. The effect of centralization of producer services such as specialized services and finance on spatial organization and the emergence of global cities that manage the world economy with the transformation of cities into transnational strategic networks have become important in terms of discussing how cities networking while acting as components of backbones. These 'institutionally fragmented' cities, which have become global nodal points, are large, dense and functionally diverse. With this density and diversity, cities transform into strategic regions and benefit from large markets, large labor pools, advanced infrastructure and specialized business services. These metropolitan areas are home to R&D facilities, universities, knowledge producing institutions and are also centers of consumption. The increase in job opportunities and residences in global cities causes problems such as traffic, competition, environmental pollution, crime and social fragmentation, and there is actually the idea that smaller cities located around these cities have greater "endogenous capacity" to keep such problems under control.

In this study, it is stated under what conditions these small cities or secondary cities are overshadowed by the first-tier city and under what conditions they borrow size by being near to a first-tier city, by being large from others, or having strong connections. Local factors have a large impact on urbanization economies, but this thesis suggests framing them with a network perspective. Urban network externalities as a concept that has come to the forefront in global cities where agglomeration externalities such as range of job opportunities, infrastructure and specialized services are intense, and looking at agglomeration externalities from a different perspective; It explains the effects of national and international networking on urban performance, urban size and competition. According to network externalities, the externalities of agglomeration can be shared in inter-city networks, and these networks allow small cities to borrow size, allowing them to develop through the benefits of agglomeration and avoiding the costs of agglomeration, but according to the concept of agglomeration shadow, which is the negative side of network externalities, these externalities can also cause competition. Access to these first-tier city-specific functions and networks not available in smaller cities increases the attractiveness of secondary cities, enabling them to achieve higher location benefits and thus borrowed size; becomes borrowed function and borrowed performance.

In the case of Turkey, the findings of the study support the hypothesis, and the effect of network connectivity on secondary city performance is higher than size and distance. This is an interesting output for Turkey, since it is still a developing country and the development differences between its provinces are very high, more agglomeration economies are effective, that is, a performance effect focused on size and proximity is expected. However, the findings confirm the hypothesis and Istanbul is in a position where the country in general can benefit from the national and international network connections, the global flows provided by these connections, and the network impact created by its regional dominance. Although Ankara and Izmir cannot carry out as intense global flows as Istanbul, they are important cities in terms of their effects on the country's economy and the performance of peripheral cities.

While Istanbul, which can be considered as a global city, dominates the country's economy with the network relations it has established, Ankara and Izmir, which follow it, feed the small cities around them through the regional networks they have created and the resources embedded in these networks. Istanbul, like other global cities, is a city whose quality of life is gradually declining due to its strong sphere of influence and its symbolism that performs at the level of country dominance. Ankara and Izmir are cities that face similar daily life problems, although not as much as Istanbul. These cities, where economic activities, social activities such as education, health and culture are concentrated and aggravated, are condemned to bad environmental conditions, high housing rents, and heavy traffic due to vehicle-oriented transportation system planning. While the quality of life in peripheral cities is relatively better, at least in terms of environmental health, it is less preferred due to the lack of work, education and other social opportunities. The fact that secondary cities borrow size from primary cities over networks, go beyond the functions and performance that they can normally exhibit as much as their own size, host more and more diverse functions, and exhibit higher performance, increases the quality of life and therefore the preferability of these cities to live in. However, since each secondary city does not have sufficient infrastructure and local capacity to be included in these networks, competition among them also leads to unequal developments. Another important question for policy practice in planning, which can fill the deficiencies of the theory of agglomeration economies, is the question of how to overcome the shadows of agglomeration caused by the competitive environment of regional networks. To maximize the benefits of agglomeration and borrowed size while minimizing the downsides of competition and interdependence, the literature on regional planning contends that a coordinated and strategic strategy is essential. This might entail the implementation of regional policies and strategies that encourage cooperation and coordinated planning while taking into consideration the interconnectedness of cities and regions. Providing infrastructure and other public goods that enable regional connectivity and reduce the costs of transportation and communication could also be an important component of it.

Globalization has fundamentally transformed urban dynamics, challenging the conventional belief that city size alone dictates economic growth. While larger metropolitan areas have historically been viewed as primary engines of aggregate gains, recent trends show a diversification in growth patterns among smaller, second-tier regions. These regions, often overshadowed by larger counterparts benefiting from the "first city bonus," exhibit varied economic potentials that defy simplistic size-based predictions. The concept of urban network externalities further complicates this narrative, emphasizing the importance of functional linkages between cities over mere geographical proximity. Smaller cities can leverage connections with larger urban centers to achieve significant productivity gains. Such interconnectedness redistributes economic opportunities more equitably across regions, positioning second-tier cities in less developed member states to potentially outpace their capital cities in economic growth over the medium term. As urbanization evolves, the distribution of services within regional urban systems increasingly reflects these complex dynamics, highlighting the growing importance of network resilience and functional connectivity in shaping global urban economies.

REFERENCES

Alonso, W. (1973). Urban Zero Population Growth. Daedalus, 102(4), 191–206. http://www.jstor.org/stable/20024174

Batten, D. F. (1995). Network Cities: Creative urban Agglomerations for the 21st century. Urban Studies, 32(2), 313–327. https://doi.org/10.1080/00420989550013103

Boix, R. (2003). NETWORKS OF CITIES AND GROWTH: THEORY, NETWORK IDENTIFICATION AND MEASUREMENT OF THE NETWORK EXTERNALITY.

Boix, R., & Trullen, J. (2004). Knowledge, networks of cities and growth in regional urban systems: theory, measurement and policy implications. ERSA Conference Papers. https://ideas.repec.org/p/wiw/wiwrsa/ersa04p85.html

Burger, M., & Meijers, E. (2016). Agglomerations and the rise of urban network externalities. Papers in Regional Science, 95(1), 5–15. https://doi.org/10.1111/pirs.12223

Burger, M., Meijers, E., Hoogerbrugge, M., & Tresserra, J. M. (2014). Borrowed size, agglomeration shadows and cultural amenities in North-West Europe. European Planning Studies, 23(6), 1090–1109. https://doi.org/10.1080/09654313.2014.905002

Camagni, R., & Capello, R. (2014). Second-Rank city dynamics: theoretical interpretations behind their growth potentials. European Planning Studies, 23(6), 1041–1053. https://doi.org/10.1080/09654313.2014.904994

Camagni, R., Capello, R., & Caragliu, A. (2014). The rise of Second-Rank cities: What role for agglomeration economies? European Planning Studies, 23(6), 1069–1089. https://doi.org/10.1080/09654313.2014.904999

Capello, R. (2000). The City Network Paradigm: Measuring Urban network Externalities. Urban Studies, 37(11), 1925–1945. https://doi.org/10.1080/713707232

Cardoso, R. (2016). Building the extensive city: processes of metropolisation in European second-tier urban regions. In Doctoral thesis, UCL (University College London). https://discovery.ucl.ac.uk/id/eprint/1493084/

Cardoso, R., & Meijers, E. (2016). Contrasts between first-tier and second-tier cities in Europe: a functional perspective. European Planning Studies, 24(5), 996–1015. https://doi.org/10.1080/09654313.2015.1120708

Cardoso, R., & Meijers, E. (2017). Secondary yet metropolitan? The Challenges of Metropolitan Integration for Second-Tier Cities. Planning Theory &

Practice, 18(4), 616–635. https://doi.org/10.1080/14649357.2017.1371789

Ciccone, A., & Hall, R. E. (1993). Productivity and the density of economic activity. https://doi.org/10.3386/w4313

De Vos, D., Lindgren, U., Van Ham, M., & Meijers, E. (2020). Does broadband internet allow cities to 'borrow size'? Evidence from the Swedish labour market. Regional Studies, 54(9), 1175–1186. https://doi.org/10.1080/00343404.2019.1699238

Dijkstra, L. (2013). Why investing more in the capital can lead to less growth. Cambridge Journal of Regions, Economy and Society, 6(2), 251–268. https://doi.org/10.1093/cjres/rst009

Dijkstra, L., Garcilazo, E., & McCann, P. (2013). The economic performance of European cities and city regions: myths and realities. European Planning Studies, 21(3), 334–354. https://doi.org/10.1080/09654313.2012.716245

Fujita, M., & Krugman, P. (2004). The new economic geography: Past, present and the future*. Papers in Regional Science, 83(1), 139–164. https://doi.org/10.1007/s10110-003-0180-0

Fujita, M., & Mori, T. (1996). The role of ports in the making of major cities: Self-agglomeration and hub-effect. Journal of Development Economics, 49(1), 93–120. https://doi.org10.1016/0304-3878(95)00054-2

Fujita, M., & Thisse, J. (1996). The Economics of Agglomeration. *Oxford Research Encyclopedia of Economics and Finance*.

Fujita, M., & Thisse, J. (2002). Economics of agglomeration: cities, industrial location, and regional growth. http://dx.doi.org/10.1017/cbo9780511805660

Fujita, M., & Thisse, J. (2013). Economics of agglomeration. https://doi.org/10.1017/cbo9781139051552

Fujita, M., Krugman, P., & Venables, A. J. (2000). The spatial economy: cities, regions, and international trade. Southern Economic Journal, 67(2), 491. https://doi.org/10.2307/1061487

Frenken, K., Van Oort, F., & Verburg, T. (2007). Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies*, *41*(5), 685–697. https://doi.org/10.1080/00343400601120296

Gaigné, C., Thisse, JF. (2021). New Economic Geography and the City. In: Fischer, M.M., Nijkamp, P. (eds) Handbook of Regional Science. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-60723-7_31

Glaeser, E. L., & Gottlieb, J. D. (2009). The wealth of cities: agglomeration economies and spatial equilibrium in the United States. Journal of Economic Literature, 47(4), 983–1028. https://doi.org/10.1257/jel.47.4.983

Glaeser, E. L., & Kohlhase, J. E. (2004). Cities, regions and the decline of transport costs*. Papers in Regional Science, 83(1), 197–228. https://doi.org/10.1007/s10110-003-0183-x

Gong, X., & Zhong, F. (2021). The impact of borrowing size on the economic development of Small and Medium-Sized Cities in China. Land, 10(2), 134. https://doi.org/10.3390/land10020134

Head, K., & Mayer, T. (2004). Chapter 59 The empirics of agglomeration and trade. In Handbook of regional and urban economics (pp. 2609–2669). https://doi.org/10.1016/s1574-0080(04)80016-6

Hu, G., & Yu-Qi, L. (2020). Progress, thoughts, and prospect of urban network research based on enterprise perspective. Dili Kexue Jinzhan, 39(9), 1587–1596. https://doi.org/10.18306/dlkxjz.2020.09.015

Krugman, P. (1991). Geography and trade. http://ci.nii.ac.jp/ncid/BA19334592

Krugman, P. (1993). FIRST NATURE, SECOND NATURE, AND METROPOLITAN LOCATION. Journal of Regional Science, 33(2), 129–144. https://doi.org/10.1111/j.1467-9787.1993.tb00217.x

Krugman, P. (1998). What's new about the new economic geography? Oxford Review of Economic Policy, 14(2), 7–17. https://doi.org/10.1093/oxrep/14.2.7

Li, J., & Sun, D. (2020). Industrial Composition and Agglomeration Shadow: Evidence from China's Large Urban Systems. Complexity, 2020, 1–11. https://doi.org/10.1155/2020/5717803

Malý, J. (2016). Small Towns in the Context of "Borrowed Size" and "Agglomeration Shadow" Debates: The Case of the South Moravian Region (Czech Republic). European Countryside, 8(4), 333–350. https://doi.org/10.1515/euco-2016-0024

McCann, P., & Ács, Z. J. (2010). Globalization: countries, cities and multinationals. Regional Studies, 45(1), 17–32. https://doi.org/10.1080/00343404.2010.505915

Meijers, E., & Burger, M. (2016). Stretching the concept of 'borrowed size.' Urban Studies, 54(1), 269–291. https://doi.org/10.1177/0042098015597642

Meijers, E., & Cardoso, R. P. (2021). Shedding Light or Casting Shadows? Relations between Primary and Secondary Cities. In Policy Press eBooks (pp. 25–54). https://doi.org/10.1332/policypress/9781529212075.003.0002

Meijers, E., Burger, M., & Hoogerbrugge, M. (2015). Borrowing size in networks of cities: City size, network connectivity and metropolitan functions in Europe. Papers in Regional Science, 95(1), 181–198. https://doi.org/10.1111/pirs.12181

Meijers, E., Hoogerbrugge, M., & Cardoso, R. (2017). Beyond polycentricity: Does stronger integration between cities in polycentric urban regions improve performance? Tijdschrift Voor Economische En Sociale Geografie, 109(1), 1–21. https://doi.org/10.1111/tesg.12292

Neary, J. P. (2001). Of Hype and Hyperbolas: Introducing the new Economic Geography. Journal of Economic Literature, 39(2), 536–561. https://doi.org/10.1257/jel.39.2.536

Ottaviano, G. I., & Puga, D. (1998). Agglomeration in the global economy: A survey of the 'New Economic Geography.' World Economy, 21(6), 707–731. https://doi.org/10.1111/1467-9701.00160

Partridge, M. D., Rickman, D. S., Ali, K., & Olfert, M. R. (2009). Do New Economic Geography agglomeration shadows underlie current population dynamics across the urban hierarchy? Papers in Regional Science, 88(2), 445–467. https://doi.org/10.1111/j.1435-5957.2008.00211.x

Phelps, N. A., Fallon, R. J., & Williams, C. (2001). Small firms, borrowed size and the Urban-Rural shift. Regional Studies, 35(7), 613–624. https://doi.org/10.1080/00343400120075885

Rosenthal, S. S., & Strange, W. C. (2004). Chapter 49 Evidence on the nature and sources of agglomeration economies. In Handbook of regional and urban economics (pp. 2119–2171). https://doi.org/10.1016/s1574-0080(04)80006-3

Rozenblat, C. (2010). Opening the Black Box of Agglomeration Economies for Measuring Cities' Competitiveness through International Firm Networks. Urban Studies, 47(13), 2841-2865.

Schmutzler, A. (1999). The new economic geography. Journal of Economic Surveys, 13(4), 355–379. https://doi.org 10.1111/1467-6419.00087

Sohn, C., Licheron, J., & Meijers, E. (2022). Border cities: Out of the shadow. Papers in Regional Science, 101(2), 417–439. https://doi.org/10.1111/pirs.12653

Şeker, A. (2020). The impacts of liner shipping connectivity and economic growth on international trade case of European Countries and Turkey. In *Handbook of research on the applications of international transportation and logistics for world trade* (pp. 139-150). IGI Global.

Taylor, P. J., & Derudder, B. (2003). World City Network: A Global Urban analysis. http://ci.nii.ac.jp/ncid/BB19627510

Tripathi, S. (2013). DO LARGE AGGLOMERATIONS LEAD TO ECONOMIC GROWTH? EVIDENCE FROM URBAN INDIA. Review of Urban and Regional Development Studies/RURDS. Review of Urban and Regional Development Studies, 25(3), 176–200. https://doi.org/10.1111/rurd.12014

OECD (2019), "Secondary cities are attracting more people: Comparison between the evolution of urban population in the Bangkok agglomeration and the evolution of urban population in secondary cities", in *Multi-dimensional Review of Thailand (Volume 2): In-depth Analysis and Recommendations*, OECD Development Pathways, OECD Publishing, Paris, https://doi.org/10.1787/9789264307674-graph15-en.

Van Meeteren, M., Neal, Z. P., & Derudder, B. (2016). Disentangling agglomeration and network externalities: A conceptual typology. Papers in Regional Science, 95(1), 61–80. https://doi.org/10.1111/pirs.12214

van Oort, F. (2004). City Growth and Innovation: Spatially Bounded Externalities in The Netherlands. Aldershot: Ashgate.

Volgmann, K., & Rusche, K. (2019). The Geography of Borrowing Size: Exploring spatial distributions for German urban regions. Tijdschrift Voor Economische En Sociale Geografie, 111(1), 60–79. https://doi.org/10.1111/tesg.12362

Yang, W., Fei, F., Wang, X., & Yu, H. (2021). Knowledge innovation network externalities in the Guangdong–Hong Kong–Macao Greater Bay Area: borrowing size or agglomeration shadow? Technology Analysis & Strategic Management, 34(9), 1020–1037. https://doi.org/10.1080/09537325.2021.1940922

Yin, H., Hong, T., & Tao, M. (2020). Urban network externalities, agglomeration economies and urban economic growth. Cities, 107, 102882. https://doi.org/10.1016/j.cities.2020.102882

Zhu, B., Pain, K., Taylor, P. J., & Derudder, B. (2021). Exploring external urban relational processes: inter-city financial flows complementing global city-regions. Regional Studies, 56(5), 737–750. https://doi.org/10.1080/00343404.2021.1921136

APPENDICES

APPENDIX A: SEGE-2017 List of Variables

APPENDIX B: Model 1-2 Descriptive Statistics

APPENDIX A
Demographic Variables

* Population density

* Age-Specific Fertility Rate

* Net Migration Rate

* Urbanization Rate

Employment Variables

* Unemployment rate

* Labor Force Participation Rate

* Ratio of Working Age Population to Provincial Population

* Ratio of Manufacturing Industry Employment in Insured Employment

* Ratio of Active Employees Covered by Social Security to Provincial Population

* Average Daily Earnings

* Average Daily Earnings - Female

Education Variables

* Literate Female Ratio

* General Secondary Education Net Schooling Rate

* Vocational and Technical High Schools Schooling Rate

* YGS Average Success Score

* Ratio of the Population with College or Faculty Graduates to the Population Aged 22 and Over

Health Variables

* Number of Hospital Beds per Hundred Thousand People

* Number of Physicians per Ten Thousand People

* Number of Dentists per Ten Thousand People

* Number of Pharmacies per Ten Thousand People

* Ratio of the Population whose premiums are paid by the State to the Provincial Population

Competitive and Innovative Capacity Variables

* Export Amount Per Capita

* Share of Manufacturing Industry Workplaces in Türkiye

* Manufacturing Industry Registered Workplace Ratio

* Industrial Electricity Consumption per Capita

* Share of Parcels Produced in OIZs in Türkiye

* Share of the Number of CSR Workplaces in Türkiye
* Number of Companies with Foreign Capital per Ten Thousand People
* Number of Trademark Applications Per Hundred Thousand People
* Number of Patent Applications Per Hundred Thousand People
* Ratio of the population with a master's degree or doctorate to the population aged 30 and over
* Share of Agricultural Production Value in Türkiye
* Share of the Number of Beds with Tourism Investment-Operation and Municipality Certificates in Turkey
* Share of Investment Amount with Incentive Certificate in Turkey

Financial Variables

* Share of Bank Loans in Turkey
* Bank Deposit Amount Per Person
* Number of Internet Banking Active Individual Customers per Thousand People
* Number of Internet Banking Active Corporate Customers per Thousand People
* Central Budget Revenue Per Capita
* GDP per capita

Accessibility Variables

* Rural Asphalt-Concrete Rural Road Ratio
* Number of Fixed Broadband Internet Subscribers per Household
* Number of Mobile Phone Subscribers per Person
* Load/Km Value of Motorways and State Roads
* Ratio of Railway Line to the Area of the Province

Quality of Life Variables

* Shopping Mall Gross Leasable Area Per Thousand People
* Ratio of the Population Served by the Drinking and Potable Water Network in the Municipality Population
* Residential Electricity Consumption per Person
* Number of Private Cars Per Thousand People
* Average Value of Sulfur Dioxide (SO_2)
* Ratio of the Population Outside the Scope of Social Security to the Provincial Population
* Number of Convicts Entering Penal Institutions Per Hundred Thousand People

APPENDIX B

Table B.1 : Model 1 descriptive statistics, distance to 1st first-tier city variable.

distance to 1st first-tier city (533,1795±362,8525)					
N	78				
Mean	533,1795	*Mean Standard Error*	41,0850		
Mean LCL 95%	451,3689	*Mean UCL 95%*	614,9901		
Trimmed Mean (5%)	516,0299	*Geometric Mean*	408,5377	*Harmonic Mean*	293,0002
Median	394,0000	*Median Error*	5,8304	*Mode*	235,0000
Standard Deviation	362,8525	*Variance*	131.661,9674	*Coefficient of Variation*	0,6805
Range	1.357,0000	*Minimum*	39,0000	*Maximum*	1.396,0000
IQR	569,7500	*Percentile 25% (Q1)*	231,2500	*Percentile 75% (Q3)*	801,0000
Mean Deviation	314,0276	*Median Absolute Deviation*	209,0000	*Coefficient of Dispersion*	0,7654
Sum	41.588,0000	*Sum Standard Error*	3.204,6269		
Total Sum Squares	32.311.840,0000	*Adjusted Sum Squares*	10.137.971,4872		
Second Moment	129.973,9934	*Third Moment*	30.892.065,7157	*Fourth Moment*	3,7951E+10
Fisher's Skewness G1	0,6723	*Skewness*	0,6593	*Skewness Standard Error*	0,2687
Fisher's Kurtosis G2	-0,7231	*Kurtosis*	2,2465	*Kurtosis Standard Error*	0,5174

Table B.2 : Model 1 descriptive statistics, urbanized area population variable.

urbanized area population (579.514,6538±597.757,2591)					
N	78				
Mean	579.514,6538	*Mean Standard Error*	67.682,6817		
Mean LCL 95%	444.741,2165	*Mean UCL 95%*	714.288,0912		
Trimmed Mean (5%)	512.310,6738	*Geometric Mean*	366.934,3665	*Harmonic Mean*	225.493,7917
Median	344.993,5000	*Median Error*	9.604,8413	*Mode*	#N/A
Standard Deviation	597.757,2591	*Variance*	3,5731E+11	*Coefficient of Variation*	1,0315
Range	2.930.422,0000	*Minimum*	29.233,0000	*Maximum*	2.959.655,0000
IQR	581.180,5000	*Percentile 25% (Q1)*	198.856,5000	*Percentile 75% (Q3)*	780.037,0000
Mean Deviation	444.091,0168	*Median Absolute Deviation*	346.222,0000	*Coefficient of Dispersion*	1,1319
Sum	45.202.143,0000	*Sum Standard Error*	5.279.249,1688		
Total Sum Squares	5,3708E+13	*Adjusted Sum Squares*	2,7513E+13		
Second Moment	3,5273E+11	*Third Moment*	3,8416E+17	*Fourth Moment*	7,6259E+23
Fisher's Skewness G1	1,8699	*Skewness*	1,8338	*Skewness Standard Error*	0,2687
Fisher's Kurtosis G2	3,4204	*Kurtosis*	6,1291	*Kurtosis Standard Error*	0,5174

Table B.3 : Model 1 descriptive statistics, total export variable.

total export (578,956±1.102,0328)					
N	78				
Mean	578,9560	*Mean Standard Error*	124,7806		
Mean LCL 95%	330,4860	*Mean UCL 95%*	827,4260		
Trimmed Mean (5%)	409,0319	*Geometric Mean*	2,7719	*Harmonic Mean*	0,0703
Median	0,5365	*Median Error*	17,7076	*Mode*	0,0980
Standard Deviation	1.102,0328	*Variance*	1.214.476,2052	*Coefficient of Variation*	1,9035
Range	4.908,9970	*Minimum*	0,0030	*Maximum*	4.909,0000
IQR	1.146,5485	*Percentile 25% (Q1)*	0,2015	*Percentile 75% (Q3)*	1.146,7500
Mean Deviation	830,7684	*Median Absolute Deviation*	856,3675	*Coefficient of Dispersion*	1.078,7119
Sum	45.158,5700	*Sum Standard Error*	9.732,8898		
Total Sum Squares	119.659.494,0135	*Adjusted Sum Squares*	93.514.667,8027		
Second Moment	1.198.905,9975	*Third Moment*	2.856.900.434,5309	*Fourth Moment*	1,0898E+13
Fisher's Skewness G1	2,2192	*Skewness*	2,1763	*Skewness Standard Error*	0,2687
Fisher's Kurtosis G2	4,9709	*Kurtosis*	7,5820	*Kurtosis Standard Error*	0,5174

Table B.4 : Model 1 descriptive statistic, total cargo variable.

total cargo (0,0084±0,0213)					
N	78				
Mean	0,0084	*Mean Standard Error*	0,0024		
Mean LCL 95%	0,0036	*Mean UCL 95%*	0,0132		
Trimmed Mean (5%)	0,0047	*Geometric Mean*	0,0630	*Harmonic Mean*	0,0079
Median	0,0020	*Median Error*	0,0003	*Mode*	0,0000
Standard Deviation	0,0213	*Variance*	0,0005	*Coefficient of Variation*	2,5297
Range	0,1550	*Minimum*	0,0000	*Maximum*	0,1550
IQR	0,0088	*Percentile 25% (Q1)*	0,0000	*Percentile 75% (Q3)*	0,0088
Mean Deviation	0,0099	*Median Absolute Deviation*	0,0010	*Coefficient of Dispersion*	4,1090
Sum	0,6570	*Sum Standard Error*	0,1882		
Total Sum Squares	0,0405	*Adjusted Sum Squares*	0,0350		
Second Moment	0,0004	*Third Moment*	4,9591E-5	*Fourth Moment*	6,7015E-6
Fisher's Skewness G1	5,3290	*Skewness*	5,2260	*Skewness Standard Error*	0,2687
Fisher's Kurtosis G2	32,4782	*Kurtosis*	33,3574	*Kurtosis Standard Error*	0,5174

Table B.5 : Model 1 descriptive statistics, secondary city performance variable.

secondary city performance (-147,0286±706,3624)					
N	78				
Mean	-147,0286	*Mean Standard Error*	79,9798		
Mean LCL 95%	-306,2887	*Mean UCL 95%*	12,2315		
Trimmed Mean (5%)	-153,4648	*Geometric Mean*	1,1493	*Harmonic Mean*	-1,2614
Median	-0,0730	*Median Error*	11,3499	*Mode*	0,2110
Standard Deviation	706,3624	*Variance*	498.947,8847	*Coefficient of Variation*	-4,8043
Range	3.575,0000	*Minimum*	-1.788,0000	*Maximum*	1.787,0000
IQR	1,0468	*Percentile 25% (Q1)*	-0,5603	*Percentile 75% (Q3)*	0,4865
Mean Deviation	452,4256	*Median Absolute Deviation*	0,4645	*Coefficient of Dispersion*	4.910,0334
Sum	-11.468,2320	*Sum Standard Error*	6.238,4241		
Total Sum Squares	40.105.145,3905	*Adjusted Sum Squares*	38.418.987,1186		
Second Moment	492.551,1169	*Third Moment*	-94.719.267,2343	*Fourth Moment*	1,0255E+12
Fisher's Skewness G1	-0,2794	*Skewness*	-0,2740	*Skewness Standard Error*	0,2687
Fisher's Kurtosis G2	1,3905	*Kurtosis*	4,2270	*Kurtosis Standard Error*	0,5174

Table B.6 : Model 2 descriptive statistics, distance to 1st first-tier city variable.

distance to 1st first-tier city (559,5139±363,9793)					
N	72				
Mean	559,5139	*Mean Standard Error*	42,8954		
Mean LCL 95%	473,9829	*Mean UCL 95%*	645,0448		
Trimmed Mean (5%)	544,8272	*Geometric Mean*	435,0904	*Harmonic Mean*	311,0776
Median	422,5000	*Median Error*	6,3358	*Mode*	#N/A
Standard Deviation	363,9793	*Variance*	132.480,9576	*Coefficient of Variation*	0,6505
Range	1.357,0000	*Minimum*	39,0000	*Maximum*	1.396,0000
IQR	573,0000	*Percentile 25% (Q1)*	237,7500	*Percentile 75% (Q3)*	810,7500
Mean Deviation	316,2654	*Median Absolute Deviation*	209,0000	*Coefficient of Dispersion*	0,7323
Sum	40.285,0000	*Sum Standard Error*	3.088,4671		
Total Sum Squares	31.946.165,0000	*Adjusted Sum Squares*	9.406.147,9861		
Second Moment	130.640,9443	*Third Moment*	26.679.190,0058	*Fourth Moment*	3,6399E+10
Fisher's Skewness G1	0,5771	*Skewness*	0,5650	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	-0,8425	*Kurtosis*	2,1327	*Kurtosis Standard Error*	0,5354

Table B.7 : Model 2 descriptive statistics, distance to 2nd first-tier city variable.

distance to 2nd first-tier city (667,5278±433,7898)					
N	72				
Mean	667,5278	*Mean Standard Error*	51,1226		
Mean LCL 95%	565,5922	*Mean UCL 95%*	769,4634		
Trimmed Mean (5%)	657,7130	*Geometric Mean*	491,0049	*Harmonic Mean*	318,3108
Median	611,5000	*Median Error*	7,5510	*Mode*	#N/A
Standard Deviation	433,7898	*Variance*	188.173,6049	*Coefficient of Variation*	0,6498
Range	1.431,0000	*Minimum*	76,0000	*Maximum*	1.507,0000
IQR	717,2500	*Percentile 25% (Q1)*	287,2500	*Percentile 75% (Q3)*	1.004,5000
Mean Deviation	379,5849	*Median Absolute Deviation*	244,0000	*Coefficient of Dispersion*	0,6175
Sum	48.062,0000	*Sum Standard Error*	3.680,8286		
Total Sum Squares	45.443.046,0000	*Adjusted Sum Squares*	13.360.325,9444		
Second Moment	185.560,0826	*Third Moment*	17.747.589,5834	*Fourth Moment*	6,0633E+10
Fisher's Skewness G1	0,2268	*Skewness*	0,2220	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	-1,2414	*Kurtosis*	1,7609	*Kurtosis Standard Error*	0,5354

Table B.8 : Model 2 descriptive statistics, urbanized area population variable.

urbanized area population (490.925,3472±473.926,8198)					
N	72				
Mean	490.925,3472	*Mean Standard Error*	55.852,8113		
Mean LCL 95%	379.558,0045	*Mean UCL 95%*	602.292,6900		
Trimmed Mean (5%)	439.201,7377	*Geometric Mean*	327.683,5719	*Harmonic Mean*	211.099,5712
Median	299.619,0000	*Median Error*	8.249,7109	*Mode*	#N/A
Standard Deviation	473.926,8198	*Variance*	2,2461E+11	*Coefficient of Variation*	0,9654
Range	1.956.197,0000	*Minimum*	29.233,0000	*Maximum*	1.985.430,0000
IQR	396.218,2500	*Percentile 25% (Q1)*	193.180,7500	*Percentile 75% (Q3)*	589.399,0000
Mean Deviation	351.437,6127	*Median Absolute Deviation*	346.222,0000	*Coefficient of Dispersion*	1,0421
Sum	35.346.625,0000	*Sum Standard Error*	4.021.402,4170		
Total Sum Squares	3,3300E+13	*Adjusted Sum Squares*	1,5947E+13		
Second Moment	2,2149E+11	*Third Moment*	1,7340E+17	*Fourth Moment*	2,4492E+23
Fisher's Skewness G1	1,6991	*Skewness*	1,6635	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	2,2264	*Kurtosis*	4,9926	*Kurtosis Standard Error*	0,5354

Table B.9 : Model 2 descriptive statistics, total export variable.

total export (468,6582±937,2907)					
N	72				
Mean	468,6582	*Mean Standard Error*	110,4608		
Mean LCL 95%	248,4057	*Mean UCL 95%*	688,9107		
Trimmed Mean (5%)	330,1661	*Geometric Mean*	1,9864	*Harmonic Mean*	0,0651
Median	0,4820	*Median Error*	16,3156	*Mode*	0,0980
Standard Deviation	937,2907	*Variance*	878.513,8461	*Coefficient of Variation*	1,9999
Range	4.659,9970	*Minimum*	0,0030	*Maximum*	4.660,0000
IQR	276,5705	*Percentile 25% (Q1)*	0,1608	*Percentile 75% (Q3)*	276,7313
Mean Deviation	702,4209	*Median Absolute Deviation*	856,4220	*Coefficient of Dispersion*	971,8974
Sum	33.743,3900	*Sum Standard Error*	7.953,1753		
Total Sum Squares	78.188.599,3019	*Adjusted Sum Squares*	62.374.483,0700		
Second Moment	866.312,2649	*Third Moment*	1.856.876.697,6210	*Fourth Moment*	6,5203E+12
Fisher's Skewness G1	2,3522	*Skewness*	2,3029	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	6,1918	*Kurtosis*	8,6879	*Kurtosis Standard Error*	0,5354

Table B.10 : Model 2 descriptive statistics, total cargo variable.

total cargo (0,0056±0,0084)					
N	72				
Mean	0,0056	*Mean Standard Error*	0,0010		
Mean LCL 95%	0,0036	*Mean UCL 95%*	0,0075		
Trimmed Mean (5%)	0,0045	*Geometric Mean*	0,0693	*Harmonic Mean*	0,0092
Median	0,0020	*Median Error*	0,0001	*Mode*	0,0000
Standard Deviation	0,0084	*Variance*	7,0587E-5	*Coefficient of Variation*	1,5085
Range	0,0440	*Minimum*	0,0000	*Maximum*	0,0440
IQR	0,0083	*Percentile 25% (Q1)*	0,0000	*Percentile 75% (Q3)*	0,0083
Mean Deviation	0,0061	*Median Absolute Deviation*	0,0010	*Coefficient of Dispersion*	2,7153
Sum	0,4010	*Sum Standard Error*	0,0713		
Total Sum Squares	0,0072	*Adjusted Sum Squares*	0,0050		
Second Moment	6,9606E-5	*Third Moment*	1,2962E-6	*Fourth Moment*	4,3049E-8
Fisher's Skewness G1	2,2798	*Skewness*	2,2321	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	6,4036	*Kurtosis*	8,8853	*Kurtosis Standard Error*	0,5354

Table B.11 : Model 2 descriptive statistics, secondary city performance variable.

secondary city performance (-273,6143±569,14)					
N	72				
Mean	-273,6143	*Mean Standard Error*	67,0738		
Mean LCL 95%	-407,3557	*Mean UCL 95%*	-139,8730		
Trimmed Mean (5%)	-209,0808	*Geometric Mean*	0,6378	*Harmonic Mean*	-1,1643
Median	-0,1385	*Median Error*	9,9071	*Mode*	0,2110
Standard Deviation	569,1400	*Variance*	323.920,3598	*Coefficient of Variation*	-2,0801
Range	1.788,9230	*Minimum*	-1.788,0000	*Maximum*	0,9230
IQR	0,9355	*Percentile 25% (Q1)*	-0,5975	*Percentile 75% (Q3)*	0,3380
Mean Deviation	440,9000	*Median Absolute Deviation*	0,4645	*Coefficient of Dispersion*	1.978,0445
Sum	-19.700,2320	*Sum Standard Error*	4.829,3132		
Total Sum Squares	28.388.611,3905	*Adjusted Sum Squares*	22.998.345,5453		
Second Moment	319.421,4659	*Third Moment*	-298.606.078,7740	*Fourth Moment*	4,0007E+11
Fisher's Skewness G1	-1,6895	*Skewness*	-1,6541	*Skewness Standard Error*	0,2789
Fisher's Kurtosis G2	1,0766	*Kurtosis*	3,9211	*Kurtosis Standard Error*	0,5354

CURRICULUM VITAE

Name Surname : **Eğinç Simay Ertürk**

EDUCATION :

- **B.Sc.** : 2021, Mimar Sinan Fine Arts University, Faculty of Architecture, Urban and Regional Planning
- **M.Sc.** : 2024, Istanbul Technical University, Graduate School, Regional Planning

PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- **Ertürk, E.S., Gezici, F.** 2024: Searching for the Impact of Network Connectivity on Borrowing Performance: The Case of Turkey. 14th World Congress of Regional Science Association International, April 7-11, 2024 Keckemet, Hungary.