WELFARE ANALYSIS OF REGIONAL POPULATION DISTRIBUTION IN TURKEY

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WELFARE ANALYSIS OF REGIONAL POPULATION DISTRIBUTION IN TURKEY

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DECLARATION OF ORIGINALITY

I, Gamze Zeki, certify that

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ABSTRACT

Welfare Analysis of Regional Population Distribution in Turkey

Rapid urbanization in the last century has been accompanied with growing number of studies on spatial economics. Determining which factors affect households' location choices is one of the most prominent topics that has been worked on in the literature. The aim of this thesis is to analyze region-specific characteristics and to examine their relative importance on location choices of households in Turkey at NUTS2 level. The thesis contributes to the current literature by providing model-based estimates for the importance of region-specific characteristics on the population allocation and welfare in Turkey, which are also used for conducting counterfactual exercises. For this purpose, a stylized spatial macroeconomic model as postulated by Desmet and Rossi-Hansberg (2013) is utilized. In the model households make consumption, investment, work and location choices by assessing three region-specific characteristics, namely regional productivity levels, amenities and excessive frictions. The counterfactual exercises, which involve eliminating one or more of the differences in characteristics across regions, result in modest increases in welfare (about 1%-2%), but large population reallocations across regions.

ÖZET

Türkiye’de Bölgesel Nüfus Dağılımının Refah Analizi

Son yüzyılda gerçekleşen hızlı şehirleşme, mekansal ekonomi üzerine yapılan artan sayıda çalışmayı da beraberinde getirmiştir. Hanehalklarının mekan seçimlerini etkileyen faktörlerin saptanması ise literatürde üzerine çalışılmış popüler konulardan biridir. Bu tezin amacı, İBBS2 düzeyindeki bölgelerin özelliklerini analiz etmek ve bu özelliklerin Türkiye’deki hanehalklarının bölgesel lokasyon seçimlerinin üzerindeki göreli önemini incelemektir. Tez, güncel literatüre bölgeye özgü özelliklerin nüfus dağılımı ve refah için önemine yönelik, karşıolgusal çalışmalar için de kullanılan, modele dayalı tahminler sağlayarak katkı yapmaktadır. Bu amaçla, Desmet and Rossi-Hansberg (2013) tarafından öne sürülen sadeleştirilmiş mekansal makroekonimik modelden faydalanılmıştır. Modelde, hanehalkları tüketim, yatırım, çalışma ve lokasyon seçimlerini bölgeye özgü üç özelliği değerlendirerek yapmaktadır: Üretim verimliliği, yaşantı kolaylığı ve yerel yönetim verimliliği. Bir veya birden fazla özellikteki bölgeler arası farklılıklar ortadan kaldırılarak yapılan karşıolgusal çalışmalarda, refah seviyesinde yaklaşık %1-%2’lik az miktarda artış gerçekleşmiş, fakat yüksek miktarda nüfus, bölgeler arası lokasyon değiştirmiştir.

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CHAPTER 1

INTRODUCTION

In the last century, the urban population at least doubled its size, and today, at least half of the world's population lives in urban areas. Nearly 30% of Japan resides in Tokyo as of 2021, while it also occupies one of the smallest lands among its other prefectures. Mumbai is the most densely populated city globally, which hosts 76,700 people per square meter. The density also is accompanied by agglomerated economic activities. For example, Istanbul, which hosts around 20% of the population in Turkey and makes up less than 1% of the total country area, has a share of 30% of total GDP in 2020.

The high degree of crowd comes with urban costs (i.e., congestion) such as depleting natural resources, increasing housing prices, or traffic. However, the question is which factors attract people to live in those cities despite these adverse effects of population density. It is important to learn the motivation that derives locational preferences of households and the implications of this kind of agglomeration on general wellbeings, especially for the policymakers. The literature on urban and spatial studies has been growing to seek answers to questions related to spatial economics in the last decade. For example, the most-known models Rosen (1979) and Roback (1982) study labor allocation across locations using wage and rent differences. Au and Henderson (2006) estimates the impact of migration restrictions on the city sizes in China. As urbanization is associated with economic growth and development, studies also focus on the impact of spatial differences on economic growth. Hsieh and Moretti (2019) analyzes the impact of local housing constraints on aggregate output growth in the Unites States (U.S.) with a spatial equilibrium model and finds that it lowers the growth by 36 percent. Besides its impact on economic growth, the impact of urban policies on welfare is frequently discussed. Desmet, Nagy, and Rossi-Hansberg (2018) suggests that global welfare would increase if full liberalization of migration is enacted. Allen and Arkolakis (2014) estimates welfare gain by 1.1-1.4% in case of the provision of the interstate highway system. These studies conduct spatial analysis via equilibrium models and mainly focus on the U.S. and European economies.

Existing studies on spatial analysis for Turkey are conducted mainly through an empirical approach, and the model-based analysis is very limited. Empirical studies mostly focus on regional disparities and regional economic convergence. For example, Gezici and Hewings (2004) and Dogan and Kındap (2019) study the inter-regional income per capita convergence with β-convergence method. Kırdar and Saracoğlu (2008) analyze the regional convergence and the impact of internal migration on regional economic growth using β-convergence method and 2SLS estimation and Asik, Karakoç, and Pamuk (2020) examines the evolution and the sources of regional inequalities. Karaalp-Orhan (2020) makes a comparative analysis on NUTS2-level regions using economic, social, and demographic indicators to analyze regional disparities. There are also studies focusing on the impact of investment on regional development. For example, Celbis and Crombrugghe (2014) analyzed the impact of internet infrastructure on NUTS2-level income disparities, and Saygılı and Özdemir (2021) studied the impact of infrastructure investment on regional economic growth. To the best of my knowledge, the only study using the spatial equilibrium model is Coşar, Demir, Ghose, and Young (2021) in which the authors examine the impact of transportation infrastructure on welfare by extending Allen and Arkolakis (2014) with endogenous labor supply. In order to fill the literature gap in model-based analysis on Turkey, I use the model in Desmet and Rossi-Hansberg (2013) to conduct spatial analysis for Turkey and answer a macro-level question: What factors do motivate individuals to choose their locations, and to what degree are these factors important for welfare?

Desmet and Rossi-Hansberg (2013) approach this question using a standard urban model in which three idiosyncratic characteristics are assigned to cities: efficiency, amenity, and excessive frictions. The model has a relatively simple setup concerning other models in literature in terms of studying the city-size distribution and has a low demand for the data. For example, Behrens, Duranton, and Robert-Nicoud (2014) approach to the agglomeration and selection mechanism with a more complex model and study the talented worker's role in city productivity by assuming heterogeneity in labor productivity. The logic behind the model in Desmet and Rossi-Hansberg (2013) is that the efficiency and amenity levels of the city attract people to move in. Increasing population density arising from the attractiveness creates frictions such as increasing traffic density, and excessive friction accounts for the ability of local government to deal with these types of friction. The authors built an urban model by assuming that the economy is at the Golden Rule steady state and made the counterfactual analysis based on this assumption after validating the general equilibrium nature of the model. Their analysis covers the U.S. and China. In Desmet and Rossi-Hansberg (2014), Mexico is included as well. This study would also help understand whether the model works for different countries.

The study for Turkey covers the period between 2009-2019 and is conducted at the NUTS2 level. The estimation period and geography level are restricted due to data availability and economic instability resulting from the Covid-19 pandemic. I first test the validity of the model for Turkey with regressions and a series of correlation analyses. Both results validate the model estimations except for the estimated amenities series. After that, I conduct four counterfactual exercises in Desmet and Rossi-Hansberg (2013). In the first one, the differences in characteristics are eliminated one at a time to evaluate the relative importance of each regional characteristic. In the second one, the differences in only one characteristic are allowed to exist in order to analyze the impact of smoothing out the differences across regions. The remaining two exercises are the versions of the first two counterfactuals, but this time conducted with a version of the model that includes production externalities.

Similar to the results for the U.S., welfare changes slightly in each exercise. However, a considerable amount of the population reallocates across the country. The most welfare gain is achieved by eliminating the differences in efficiency, and the least gain is obtained by eliminating the differences in excessive frictions. Different than the U.S. case, welfare loss occurs when allowing the differences only in efficiency. Integration of production externalities does not considerably affect the change in welfare and the overall population reallocation compared to the results in the first two exercises. The main impact is that the magnitude of the change in regional population size is amplified.

The structure of this paper will be as follows. Chapter 2 summarizes the urban model constructed by Desmet and Rossi-Hansberg (2013). Chapter 3 describes the estimation methodology for the model validation and introduces the results. Chapter 4 presents the counterfactual exercises and the result of the analysis. Chapter 5 concludes.

CHAPTER 2
MODEL

The model used in Desmet and Rossi-Hansberg (2013) is a spatial macroeconomic model which has cities with idiosyncratic levels of productivity, excessive friction, and amenities. Cities are monocentric and circular with a diameter of d, in which the production side is placed at the center of each city. Agents reside within the surroundings of the production site. The agents that inhabit away from the center are subject to a commuting fee to reach the production site. The local government is responsible for the provision of infrastructure for transportation and finances its expenditures via labor tax. The efficiency of each government may vary when providing transportation services. This variation is called excessive friction. Labor supply is elastic, which creates distortions in the economy through labor tax.

2.1 Technology

There are N_t workers, and the number of workers in each city is represented by N_{it}, which denotes the population size of city i at time t. Production is described by the Cobb Douglas production function with constant returns to scale,

$$Y_{it} = A_{it} K_{it}^{\vartheta} H_{it}^{1-\vartheta} \tag{1}$$

where A_{it} is the city-level productivity, K_{it} is city-level total capital and H_{it} is total hours worked in city i. As labor is, the capital is also freely mobile within the economy and across all cities. Therefore, each city is subject to the same level of interest rate. When we examine the first-order condition of the firm's problem with respect to H_{it}, we may encounter differences in wages for each city in equilibrium. Then, the efficiency wedge can be defined as A_{it} in the following form

$$A_{it} = \frac{Y_{it}}{K_{it}^{\vartheta} H_{it}^{1-\vartheta}}. \tag{2}$$

First order conditions of the firm problem will be

$$\begin{aligned} w_{it} &= (1-\vartheta)\frac{y_{it}}{h_{it}} \\ r_t &= \vartheta\frac{y_{it}}{k_{it}} \end{aligned} \tag{3}$$

where lowercase letters represent per capita variables.

2.2 Preferences

Each agent pays housing rent to occupy a unit of land and commuting fee. With a given city i_0 and capital k_0 at t = 0, the agent's problem will be the following:

$$\max_{c_{i_t,t},h_{i_t,t},k_{i_t,t},i_t} \sum_{t=0}^{\infty} \beta^t[\log c_{it} + \varphi \log(1-h_{it}) + \gamma_i] \tag{4}$$

subject to

$$c_{it} + x_{it} = r_t k_{it} + w_{it} h_{it}(1-\tau_{it}) - R_{it} - T_{it} \tag{5}$$

$$k_{i,t+1} = (1-\delta)k_{it} + x_{it} \tag{6}$$

where φ denotes the relative preference for leisure, γ_i is the city i's amenity level, x_i is investment, τ_i is a city-specific labor tax rate, R_i is the land rent and T_i is commuting cost. τ_i can be defined as a labor wedge, resulting in distortion in the optimal consumption-leisure decision. In this model, the labor wedge resulting from τ_i is considered a labor tax. However, it can be represented with a variable other than labor taxes, such as time spent during commuting, unionization, and land regulations.

Intratemporal optimality condition from consumers' problem and equations in (3) suggests

$$(1-\tau_{it}) = \frac{\psi}{(1-\vartheta)}\frac{c_{it}}{(1-h_{it})}\frac{h_{it}}{y_{it}} \tag{7}$$

Agents are able to move freely across cities, therefore, in each period, the utility is determined by the economy-wide utility function:

$$\bar{u}_t = \log c_{it} + \varphi \log(1-h_{it}) + \gamma_i \tag{8}$$

2.3 Commuting costs, land rents, and city equilibrium

Each city is monocentric and circular with a diameter of d. Other assumptions regarding the city structure are the following:

- Each city has agricultural lands around it which can be transformed into an urban area without any cost.
- All agents live in an urban area and do not migrate to a rural area.
- In equilibrium, land rents are continuous. This is to eliminate arbitrage opportunities. As a result, rents should be equal to 0 at the city boundary.

Because all agents are identical, in equilibrium, the total cost of commuting plus rent for a unit of land should be identical for all locations in each city. Therefore, in equilibrium, the following equations will be obtained based on the assumptions and city structure:

$$R_{it}(d) + T_{it}(d) = T(\bar{d}_{it}) = \varkappa \bar{d}_{it} \tag{9}$$

for all $d_{it} \in [0, \bar{d}_{it}]$.

Average land rents:

$$AR_{it} = \frac{2}{3}\varkappa \left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}} \tag{10}$$

or

$$\ln N_{it} = o_1 + \frac{1}{2}\ln AR_{it} \tag{11}$$

Total miles commuted

$$TC_{it} = \frac{2}{3}N_{it}^{\frac{3}{2}}\pi^{-\frac{1}{2}} \tag{12}$$

where $\varkappa$ is commuting cost per mile.

2.4 Government budget constraint

To finance the expenditure for transportation services, each city government levies labor taxes, τ_{it}. The government budget constraint will be

$$g_{it}h_{it}w_{it}\varkappa TC_{it} = \tau_{it}h_{it}N_{it}w_{it} \tag{13}$$

where government expenditure (left-hand side) is equal to total tax revenue. The government hire $g_{it}\varkappa$ workers to build and maintain transportation infrastructure. From equation (8) and (9), the labor wedge can be expressed as

$$\tau_{it} = g_{it}\varkappa\frac{2}{3}\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}} \tag{14}$$

or

$$\ln\tau_{it} = o_2 + \ln g_{it} + \frac{1}{2}\ln N_{it} \tag{15}$$

As discussed shortly in 2.2., the model specifically regards labor tax as labor wedge, however, it entails all sources of factors that distort the agent's optimal labor decision. If we consider both taxes and other distortions, we can break down the labor wedge as

$$1 - \tau_{it} = (1 - \tau'_{it})\left(\frac{1 - \tau_{ith}}{1 - \tau_{itc}}\right). \tag{16}$$

τ_{ith}, τ_{itc} and τ'_{it} are respectively labor tax rate, consumption tax rate and other distortions. Because there are no different tax policies between regions in terms of labor and consumption tax in Turkey, I will focus on other distortions.

2.5 Equilibrium

The analysis in Desmet and Rossi-Hansberg (2013) assumes that the economy is in steady state and the capital stock is at its Golden Rule level. As a result, following equations are obtained.

- Budget constraint:

$$c_{it} = w_{it}h_{it}(1 - \tau_{it}) - R_{it} - T_{it} = (1 - \vartheta)(1 - \tau_{it})y_{it} - \varkappa\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}} \tag{17}$$

- From the problem of firms, optimal capital decision suggests $r_t k_{it} = \vartheta y_{it}$. Therefore,

$$y_{it} = A_{it}^{\frac{1}{1-\vartheta}}\left(\frac{\vartheta}{r_t}\right)^{\frac{\vartheta}{1-\vartheta}} h_{it} \tag{18}$$

- We can drive optimal consumption and leisure choices using equation (7),

$$c_{it} = \frac{(1-\vartheta)(1-\tau_{it})A_{it}^{\frac{1}{1-\vartheta}}\left(\frac{\vartheta}{r_t}\right)^{\frac{\vartheta}{1-\vartheta}} - (R_{it}+T_{it})}{1+\psi} \tag{19}$$

$$h_{it} = \frac{1}{(1+\psi)}\left(1 + \frac{\psi(R_{it}+T_{it})}{(1-\vartheta)(1-\tau_{it})}\frac{\left(\frac{r_t}{\vartheta}\right)^{\frac{\vartheta}{1-\vartheta}}}{A_{it}^{\frac{1}{1-\vartheta}}}\right) \tag{20}$$

Then, the economy-wide utility in general equilibrium will be

$$\begin{aligned}\bar{u}_t = {}& \psi\log\psi - (1+\psi)\log(1+\psi) + \log\left((1-\vartheta)\left(1-\varkappa g_{it}\frac{2}{3}\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}\right)\frac{A_{it}^{\frac{1}{1-\vartheta}}}{\left(\frac{r_t}{\vartheta}\right)^{\frac{\vartheta}{1-\vartheta}}}\right.\\ & \left. -\varkappa\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}\right) + \psi\log\left(1 - \frac{\varkappa\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}}{(1-\vartheta)\left(1-\varkappa g_{it}\frac{2}{3}\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}\right)}\frac{\left(\frac{r_t}{\vartheta}\right)^{\frac{\vartheta}{1-\vartheta}}}{A_{it}^{\frac{1}{1-\vartheta}}}\right) + \gamma_{it}\end{aligned} \tag{21}$$

If we consider equation (17) as an implicit function of city-specific characteristics, economy-wide interest rate and utility, it can determine the city size N_{it}. As in Desmet and Rossi-Hansberg (2013), I will investigate the impact of the characteristics $(A_{it}, \gamma_{it}, g_{it})$ on N_{it} through (17). We can also derive following dynamics via (17).

$$\frac{\partial N_{it}}{\partial A_{it}} > 0, \ \frac{\partial N_{it}}{\partial \gamma_{it}} > 0, \ \frac{\partial N_{it}}{\partial g_{it}} < 0 \tag{22}$$

These are intuitive in the sense that more productive cities, the cities with more efficient local governance, or the cities with more amenities host a higher population level.

Labor market clearing condition below governs $\bar{u}_t$,

$$\sum_{i=1}^{I} N_{it} = N_t. \tag{23}$$

CHAPTER 3

EMPIRICAL VALIDATION OF THE MODEL

In this section, I will present the methodology in Desmet and Rossi-Hansberg (2013) based on the general equilibrium nature of the model, the data used for Turkey, and the estimation results for the model validation. The empirical approach to validate the implications of the general equilibrium model is detailed in the first subsection. In the second subsection, I will elaborate on the data sources and methods I used to construct the data set. In the third subsection, the results of the validation estimations are shared.

3.1 Empirical approach

3.1.1 Testing the general equilibrium nature

Desmet and Rossi-Hansberg (2013) test the nature of general equilibrium through the series of regression equations. City-specific characteristics used in the following equations are identified via the model equations. Firstly, I estimate efficiency and labor wedges using equations (2) and (7), respectively.

The methodology starts with the following regression equation:

$$\ln N_{it} = \alpha_1 + \beta_1 \ln A_{it} + \varepsilon_{1it}. \tag{24}$$

As stated in (22), population size increases with an increase in efficiency wedge. Following this link, (24) is constructed. In (24), β_1 captures this impact (i.e. $\beta_1 > 0$) and $\beta_1 \ln A_{it} = \ln\tilde{N}_{it}(A_{it})$ captures the population size explained by efficiency wedge. ε_{1it} is the remaining population size associated with other factors which are γ_{it} and g_{it} according to the model. Therefore, error term is redefined as $\tilde{\varepsilon}_1(g_{it}, \gamma_{it})$.

According to (12) and (14), total commuting rises due to greater population size resulting from an increase in efficiency wedge, which creates more distortion in the city. This impact of productivity on the labor wedge is estimated by

$$\ln\tau_{it} = \alpha_2 + \beta_2 \ln\tilde{N}_{it}(A_{it}) + \varepsilon_{2it}. \tag{25}$$

Based on this inference from the model and related equations, $\beta_2 > 0$. The impact of productivity on distortions is defined as $\ln\tilde{\tau}_{it} = \beta_2 \ln\tilde{N}_{it}(A_{it)})$. We can infer from (14) and (24) that ε_{2it} is related to g_{it} and $\tilde{\varepsilon}_1(g_{it}, \gamma_{it})$ and redefine the error terms as $\tilde{\varepsilon}_2(g_{it}, \tilde{\varepsilon}_1(g_{it}, \gamma_{it}))$.

Next, when we consider (10), the impact of city-specific characteristics on average rents can be separately estimated using (11) and equation (22) by

$$\ln AR_{it} = \alpha_3 + \beta_3 \ln\tilde{\tau}_{it} + \beta_4 \varepsilon_{1it} + \beta_5 \varepsilon_{2it} + \varepsilon_{3it}. \tag{26}$$

As higher efficiency increases population size, an increase in population size amplifies distortions and average rents. Hence, the model clearly suggests that $\beta_3 > 0$. First, note that $\tilde{\varepsilon}_2(g_{it}, \tilde{\varepsilon}_1(g_{it}, \gamma_{it}))$ is associated with amenities only through $\tilde{\varepsilon}_1(g_{it}, \gamma_{it})$ and both error terms are included in (26). Therefore, β_5 seizes only the impact of excessive friction and β_4 captures only the impact of amenities on average rents, since we are controlling for the impact of excessive friction by ε_{2it}. (22) implies that higher excessive frictions decreases populations size and higher amenities has a positive impact on population size. Therefore, we expect β_4 to be positive and β_5 to be negative based on (10). Lastly, we can also rearrange (11) and estimate the following equation

$$\ln N_{it} = \alpha_4 + \beta_6 \ln AR_{it} + \varepsilon_{4it}. \tag{27}$$

As in (11), the circular shape of cities suggests that $\beta_5 = 2 > 0$.

3.1.2 Estimation of excessive frictions, model parameters and amenities

Estimation of g_{it}, parameters and γ_{it} to be used in counterfactual exercises is model-driven. Firstly, if we rearrange (14) as a log-linear regression as follows,

$$\ln\tau_{it} - \frac{1}{2}\ln N_{it} = \alpha_5 + \varepsilon_{5it}, \tag{28}$$

ε_{5it} can be identified as $\ln g_{it}$ by imposing zero mean assumption. This allows us to make the following interpretation: $\ln g_{it}$ accounts for the excessive distortions besides the amount which city size predicts. For instance, $\ln g_{it}$ being less than zero means $g_{it} < 1$ which suggests us that local government provides the infrastructure less costly than the city size predicts in (13). We can decompose α_5 in (28) as

$$\alpha_5 = \ln\frac{2}{3} + \ln\varkappa - \frac{1}{2}\ln\pi \tag{29}$$

by which $\varkappa$ is estimated with given α_5 values. I follow the estimation method suggested by Desmet and Rossi-Hansberg (2014) to estimate leisure parameter. I estimate the parameter with country-level data by using equation (7) and setting aggregate τ equal to 0. The estimated values for $\varkappa$ and ψ are 0.001 and 1.446 respectively. I choose $\vartheta = 0.32$ estimated by Atiyas and Bakis (2015) and $r = \delta = 0.065$ estimated by Toraganlı Karamollaoğlu (2018). Only variable left be estimated is γ_{it}. Before estimating the series, Desmet and Rossi-Hansberg (2013) rewrite (19) by using the approximation ($\log(1\text{-}x) \approx \text{-}x$) and assuming that τ_{it} and g_{it} are small in the following form.

$$\bar{u}_t = \psi\log\psi - (1+\psi)\log(1+\psi) - \left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}} \left(g_{it}\varkappa\frac{2}{3} - \frac{\varkappa\psi}{(1-\vartheta)A_{it}^{\frac{1}{1-\vartheta}}\left(\frac{\vartheta}{r_t}\right)^{\frac{\vartheta}{1-\vartheta}}} \right) + \gamma_{it} \tag{30}$$

The series of amenities are the values that match the city sizes when setting $\bar{u}_t$ to a certain value. $\bar{u}_t$ will be set equal to 10 as in Desmet and Rossi-Hansberg (2013). The estimated values behave as a residual in (30). I utilize the data shared in Boğaziçi

University Center for Economics and Econometrics (2011) and Şeker et al. (2012) to test the model-driven amenity values by correlation analysis.

3.2 Data

Due to data limitations, the data set that I use to generate model variables is at the NUTS2 level and covers 2009-2019. There are 26 NUTS2 regions in Turkey consisting of provinces determined based on economic, social, cultural, and other characteristics. The data is also used in three-year averages between 2009 and 2019. It is mainly due to the availability of consumption and housing rent estimation only at three-year averages at the NUTS2 level.

All monetary variables are deflated and converted into the constant U.S. dollars of last year of each three-year period. While the capital stock is deflated with PPI, the remaining monetary variables are deflated with CPI. Since the Covid-19 pandemic intensified the economic instability, the period beyond 2019 is excluded. The estimation results are in Appendix A, Table A3.

3.2.1 Population

Province level population retrieved from TURKSTAT (2021c) is aggregated up to the NUTS2 level.

3.2.2 Production

GDP is used as a measure of production. It is retrieved from TURKSTAT (2021a) at the province and industry level and aggregated up to the NUTS2 level for the purpose of analysis.

3.2.3 Capital stock

The region-level capital stock is estimated in three steps. First, aggregate capital stock is estimated by the PMI method setting the average growth rate as 4.5% and depreciation rate as 6.5% (Toraganlı Karamollaoğlu (2018)) and using gross fixed capital investment shared in TURKSTAT (2021b). Second, I estimated the capital share of each NACE10 industry in aggregate capital stock using the information on tangible assets on the balance sheets in the data set of the Entrepreneurship Information System provided by the Ministry of Industry and Technology. Third, I estimate region-level capital stock using the GDP share of each region for each industry to distribute industry-level capital stock. The formula I use is as below:

$$\mathrm{CapitalStock}_{\mathrm{it}} = \mathrm{TotalCapitalStock}_{\mathrm{t}} \left(\frac{\mathrm{TangibleAsset}_{\mathrm{jt}}}{\mathrm{TotalTangibleAssets}_{\mathrm{t}}} \right) \left(\frac{\mathrm{GDPshare}_{\mathrm{jit}}}{\mathrm{TotalGDP}_{\mathrm{jt}}} \right) \quad (31)$$

where i, j and t denote region, industry (NACE10) and period. The reason behind this method is that the ratio of aggregate tangible assets to GDP is 0.5-0.6 in the firm-level micro data, which is unexpectedly low. Therefore, I use only the industry share of tangibles within total.

3.2.4 Hours worked

Weekly working hours are reported annually for each individual at the NUTS2 level in the Labor Force Survey conducted by TURKSTAT. Aggregate and average annual working hours are computed using weight coefficients for workers that have weekly working hours with positive values. The share of time is calculated by dividing the average working hours for each individual by the annual total hours available for work, which is 5110.

3.2.5 Wages

Monthly earnings and weekly working hours reported for each individual with weight coefficients in the Labor Force Survey are used to compute the average hourly wage per individual for each region and year.

3.2.6 Private consumption

Monthly total consumption for the list of consumption items is reported for each household at the NUTS2 level in the Household Budget Survey conducted by

TURKSTAT.

3.2.7 Housing rental prices

Monthly rent for rental-occupied housing is reported for each household at the NUTS2 level in the Household Budget Survey conducted by TURKSTAT. For each region and period, the median rent is used for housing rental prices.

3.2.8 Amenities

I use climate and quality-of-life variables to validate the estimates of region-level amenities. Climate variables cover the average lowest temperature in January, annual precipitation, number of days with precipitation, relative humidity in July, and the average highest temperature in July, which are shared for each province by the Turkish State Meteorological Service. Their average values within each region are used for the analysis. Quality-of-life variable are retrieved from two competitiveness indexes: *Türkiye'nin Şehirleri Sürdürülebilirlik Araştırması* shared by Boğaziçi University Center for Economics and Econometrics (2011) and *Küresel Rekabet Endeksi - Türkiye 26 Bölge - 81 İl* shared by Şeker et al. (2012). I take health, education, crime, culture and art, natural resources, and physical infrastructure index scores from Boğaziçi University Center for Economics and Econometrics (2011) and health, education, tourism, technological infrastructure, physical infrastructure, transportation, and social life index scores from Şeker et al. (2012).

3.2.9 Measures of excessive frictions

I use annual municipality expenditure per individual and average speed at 85 percentile as a measure of excessive friction. Annual municipality expenditures are shared by The Ministry of Treasury and Finance (2021), and the data on the average vehicle speed at the 85 percentile is shared by The General Directorate of Highways (2021).

3.3 Validation results

As refugee influx and instabilities created various distortions in the Turkish economy during the more recent part of the analyzed time period, I present the validation analysis for the entire period (2009-2019) and the pre-influx period (2009-2012).

I first introduce the results for regressions in 3.1.1. Time fixed effect is included in all regressions. As presented in Tables 1 and 2, all coefficients have the signs that the model predicts and are statistically significant at a 1% level. The value for β_6 is close to two, and at a 5% significance level, I fail to reject the hypothesis that $\beta_6 = 2$.

Table 1. Regression results for 2009-2019

Coefficient	TR Estimate	US Estimate	SE	p-value	R^2	Theoretical prediction
β_1	1.8559	2.0964	0.6610	0.010	0.314	(+)
β_2	0.1011	0.4127	0.0232	0.000	0.089	(+)
β_3	4.3108	0.1283	0.2593	0.000	0.902	(+)
β_4	0.1201	0.0959	0.0197	0.000	0.902	(+)
β_5	-0.2281	–0.2020	0.0676	0.001	0.902	(-)
β_6	1.8968	2.1400	0.4942	0.001	0.412	2

Table 2. Regression results for 2009-2012

Coefficient	Estimate	SE	p-value	R^2	Theoretical prediction
β_1	1.8326	0.6149	0.006	0.3283	(+)
β_2	0.1789	0.0493	0.000	0.1536	(+)
β_3	2.9729	0.2736	0.000	0.7934	(+)
β_4	0.1840	0.0361	0.000	0.7934	(+)
β_5	-0.3521	0.1281	0.006	0.7934	(-)
β_6	1.9066	0.4357	0.000	0.5495	2

Results draw inferences about the interaction between region size and region characteristics. More efficient regions have larger populations. This is also a stylized fact in the spatial economics literature, and it is explained through talent or firm sorting or the variety of intermediate inputs (Baum-Snow and Pavan (2012), Gaubert (2018) and Davis and Dingel (2019)). Next, more efficient cities are exposed to more distortion. This is due to the positive effect of productivity on population size. Third, distortions arising from being more efficient and hence having a larger population are positively associated with median rents (Albouy (2016)). Cities with better amenities that attract more households are likely to have higher land rents (Rappaport (2009)). Also, excessive frictions have a negative impact on land rents through the negative impact on population size (Albouy (2009)).

I next compare the estimates of city characteristics with their direct empirical measures. First, I find a strong positive correlation (0.86) between real wages and efficiency wedges. As for amenities, I collect data from two city competitiveness indices on the quality of life measures such as education, infrastructure, health, crime, and social life. As shown in Appendix A, Table A4, 12 out of 13 correlations between the estimates of amenities and the quality-of-life measures have the expected sign as in Desmet and Rossi-Hansberg (2013), and all are statistically significant at the 1% level. However, considering that indices have ascending values for better amenities, these correlation results are controversial. Because residuals from the model equation are regarded as amenities series, and the indices consider tangible factors, it is highly likely that residuals are also related to intangible factors like cultural and social ties. Due to this fact, analysis of amenities is open to further studies.

As the authors suggest, I conduct correlation analysis between the labor wedge and the measures of frictions to test the series of excessive frictions. I use two measures: local government spending per capita and regional average vehicle speed at 85 percentile. I analyze both 2009-2011 and 2009-2019. The correlation between government spending per capita and labor wedge is 0.27 for 2009-2011 and 0.17 for 2009-2019. The correlation between the average vehicle speed at 85 percentile and the labor wedge is -0.18 for 2009-2011 and -0.11 for 2009-2019, which satisfies the expectation.

CHAPTER 4

COUNTERFACTUAL EXERCISES

In the first section, I explain the method to run counterfactuals in Desmet and Rossi-Hansberg (2013) and share the analysis results in the next section.

4.1 Methodology

If we rearrange the equation (28), we can obtain population as a function of city characteristics, economy-wide utility, and model parameters as follows:

$$N_{it} = \frac{\pi}{\chi^2}\left(\frac{\log(C_2(A_{it}, r_t) - C_1(\bar{u}, \gamma_{it})}{\frac{1+\psi}{C_2(A_{it}, r_t)} + \frac{2}{3}g_{it}}\right)^2 \tag{32}$$

With any given values of $(A_{it}, \gamma_{it}, g_{it})$, the model calculates population size via (30). Using this function, counterfactual city-size distribution can also be calculated by setting parameters or characteristics to certain values for all cities with certain features. For example, we can analyze the impact of setting productivity equal across all regions or improving productivity in worst-performing regions on welfare and examine labor reallocation and the changes in city sizes. These types of counterfactuals can help compare the importance of city characteristics. New $\bar{u}_t$ for each counterfactual is reached when city sizes meet the labor market clearing condition (21).

4.2 Counterfactuals

For the analysis, I use data from 2009-2011, since during this period the population allocation was not yet affected by the refugee influx and the U.S. dollar to Turkish lira exchange rate was relatively less volatile than in the later periods. All estimated region-specific characteristics for counterfactuals are presented in Appendix A, Table A5. The maps depicting the distribution of regional characteristics for the time period subject to analysis (see Figure B1) and counterfactual results (see Figure B1) are

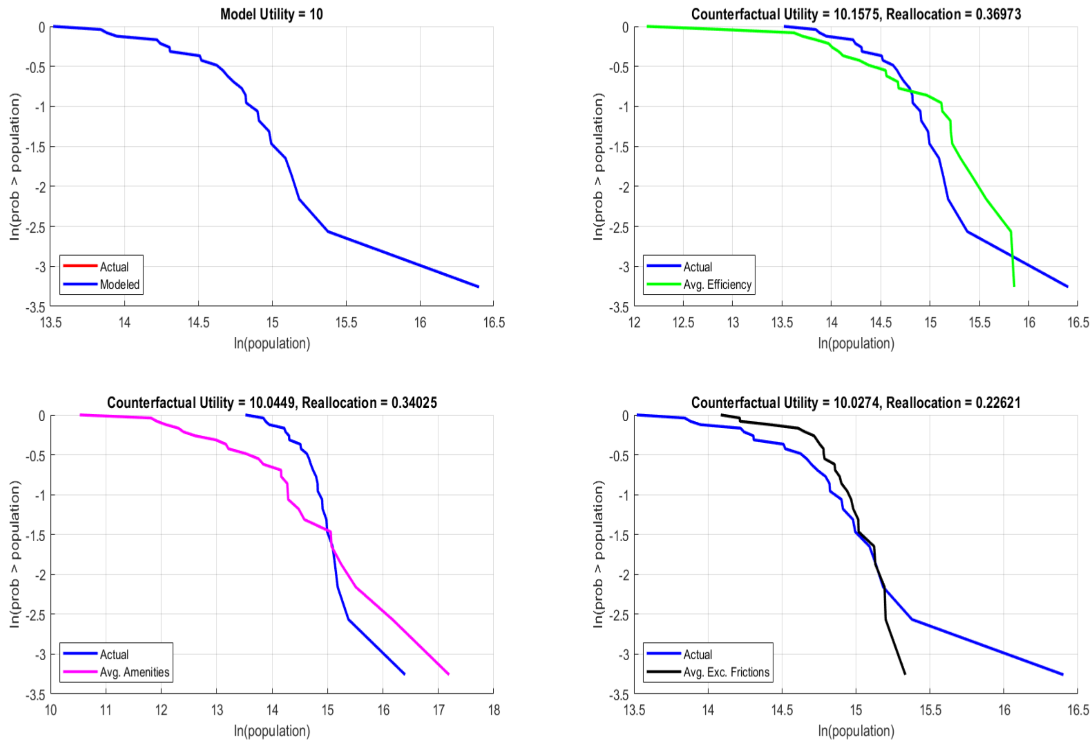


Figure 1. Counterfactual region size distribution when eliminating the differences in only one characteristic.

presented in Appendix B. I start counterfactual exercises with the case when the differences in only one characteristic are eliminated. This first exercise equates the values to the population-weighted averages for each characteristic.

Figure 1 shows the counterfactual results. In each figure provided in this study, the upper-left graph presents the actual distribution while others display actual and counterfactual distributions. The horizontal axis represents the log of population size, and the vertical axis represents the log of the probability of regions larger than that size. For any chosen population size, corresponding values of log probability indicate the share of regions larger than that size.

Results indicate that the utility increases in each scenario when the differences in one characteristic are eliminated. However, the amounts of changes are modest. The most significant change occurs when shutting down the differences in productivity which is a 1.5% increase. Welfare gain is around 0.5% if amenities values are at the same level and around 0.3% in case of same level excessive frictions. In Desmet and Rossi-Hansberg (2013), in the U.S. case, changes in welfare are 1.2%, 0.2%, and 0.8%, respectively, while increase in welfare for China rises up to 50%. Additionally, if the variations in all region characteristics are smoothed out in Turkey, the welfare gain becomes 0.8%.

Population allocation is the highest in the case of average efficiency, and around 30 million agents move into other locations to achieve a new equilibrium. Large regions with higher efficiency lose a large portion of their population. For example, Izmir loses almost 70% of its size, while the sizes of Trakya and Mardin subregions double. Kocaeli subregion, of which population size is moderate but has relatively high efficiency, also loses its size by 66%. Istanbul and Ankara lose almost 100% of their sizes, although they have better local governance. An interesting comparison in this counterfactual would be between Hatay and Zonguldak subregions. These regions have similar efficiency and amenities values. What differentiates Hatay subregion from Zonguldak subregion is that Hatay region is triple the size of Zonguldak region and has a much lower excessive friction level. When the differences in efficiency level are smoothed out, Zonguldak region increases its size only by half of the increase in Hatay subregion. When considering zero mobility cost, this case demonstrates the extent of the restrictive impact of regional frictions on mobility.

When equalizing excessive frictions, the regions with more efficient local governments decline in size without exception. In other words, the level of excessive frictions, and the change in region-level population size act in tandem. Istanbul's size is the one that shrinks the most due to its strong comparative advantage in local governance. While Istanbul loses its size by 75%, Erzurum subregion doubles its size, which is one of the least populated regions and regions with higher excessive frictions. If the differences in amenities are eliminated, we can see that Aydın and Adana subregions lose their size by 25% and 55%, while Bursa and Kocaeli subregions moderately increase their size by 20% and 10%. Also, according to these results, dispersion decreases the most in case of average excessive frictions but increases in case of average amenities.

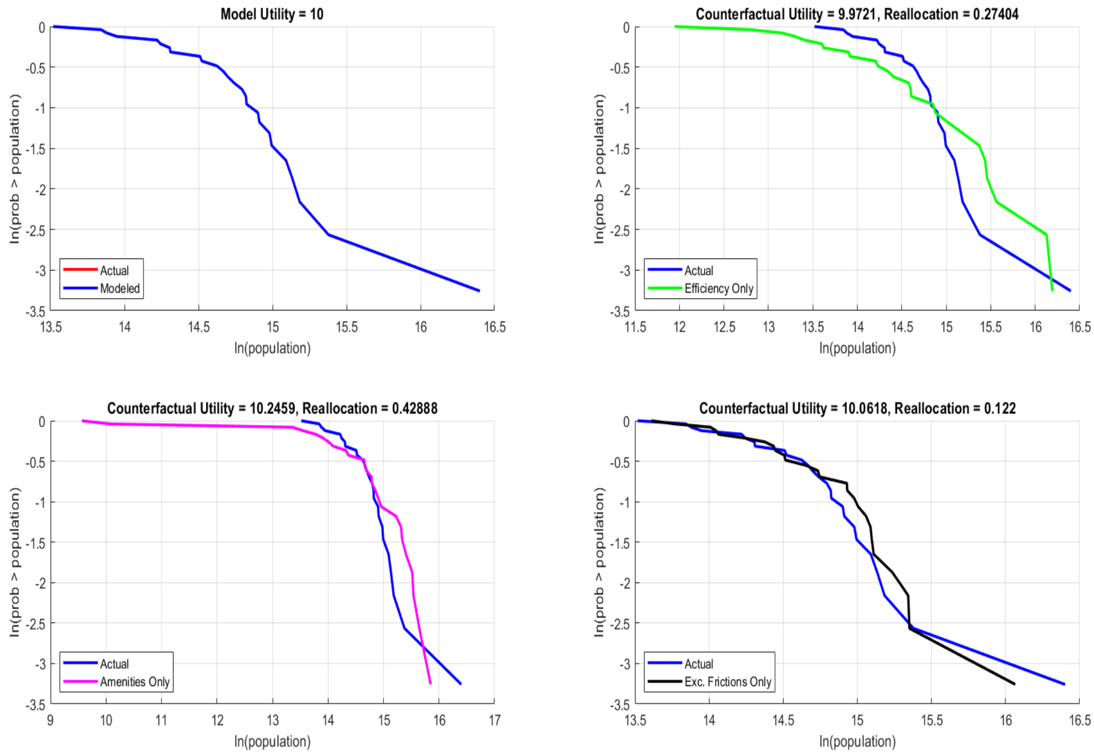


Figure 2. Counterfactual region size distribution when allowing the differences in only one characteristics.

Small changes in welfare in Turkey case could be the result of several reasons. One reason could be that individuals are already mobile enough to move to a location that maximizes their utility. This is reasonable considering the magnitudes of welfare changes and mobility restrictions in China, for instance. China has restrictions on moving into another region, and assuming perfect mobility looses this restriction, and as a result, the counterfactuals reveal the potential welfare gain. Other reasons would be, for example, the fact that a decrease in productivity is mitigated by having more leisure, or the effect of a decrease in amenities is compensated by lowering the cost of providing city infrastructure as a result of decreasing population.

Figure 2 displays the counterfactual results for the case when only one of the characteristics is allowed to differ across regions. The other two are set equal to their population-weighted averages. We can infer the impact of each characteristic on the heterogeneity across regions. The first thing to remember is that in Desmet and Rossi-Hansberg (2013), all counterfactual exercises result in welfare gain for the U.S.. However, compared to the first exercise and the U.S. case, here we experience a decline in welfare when only the differences in efficiency are allowed. In this case, more productive regions mostly end up with more residents, except for Istanbul. Also, variation in size distribution for each characteristic behaves differently. While the first exercise has the least variation in excessive frictions and most variation in amenities, we have the opposite case here. This result indicates the relative importance of efficiency and excessive frictions.

The reason behind the decline in welfare in the case of average efficiency is that most of the regions in Turkey attract individuals heavily due to their advantages in amenities and excessive frictions rather than efficiency. Because we eliminate those advantages and those regions that lose their advantages are highly lagged in efficiency, allowing only efficiency to differ causes a welfare loss. Reallocation also mainly occurs towards more efficient regions. These regions with higher efficiency are already populated and initially have the most efficient local government. Having more residents and lowering their local government efficiency by setting it to its average create more distortions and frictions in a way that net changes are negative. For example, Trabzon subregion with the third-most efficient local governance, the second-lowest efficiency, and relatively better amenities, loses 85% of its population, while Balıkesir subregion, a subregion with one of the highest efficiency values, and Ankara double their sizes.

4.3 Counterfactuals with production externality

In previous sections, productivity is assumed to be exogenous. However, the city size also boosts productivity due to agglomeration advantages such as larger knowledge spillovers. Therefore, incorporating the agglomeration effect into the model has the potential to change the results. The following formula is used to endogenize productivity:

$$A_{it} = \tilde{A}_{it} N_{it}^{\omega} \tag{33}$$

Productivity is composed of exogenous productivity and city population, and ω is the elasticity of productivity with respect to population size. ω estimations used

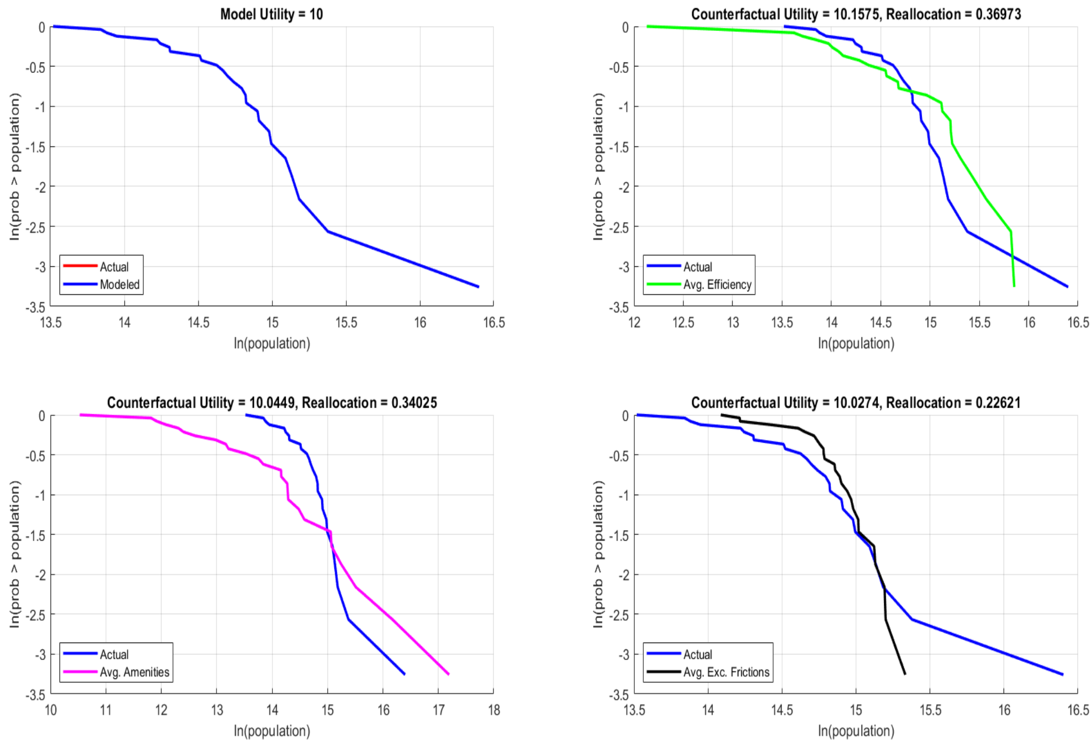


Figure 3. Counterfactual region size distribution with externalities when eliminating the differences in only one characteristics.

in Desmet and Rossi-Hansberg (2013) are taken from Carlino, Chatterjee, and Hunt (2007), Combes, Duranton, Gobillon, Puga, and Roux (2012) and Behrens et al. (2014). I estimate ω as 0.0146 for Turkey using the same estimation method in Behrens et al. (2014). The externalities in this model only accounts for the externalities within regions.

Figure 3 presents the results for the counterfactual exercise, which sets one characteristic to population-weighted averages, and Figure 4 presents the results for the counterfactual exercise, which allows one characteristic to to vary across regions. Compared to the case without production externality, there is a slight change in welfare and reallocation. In Desmet and Rossi-Hansberg (2013), a similar case occurs in the counterfactual for the U.S.. Making regions have the same level of characteristics reduces overall welfare, since it impedes regions from benefiting from externalities. Incorporating externalities decreases the exogenous efficiency level of more populated regions. Because underlying differences across regions are reduced, adjusting commuting costs with the change in region size under the externality setup

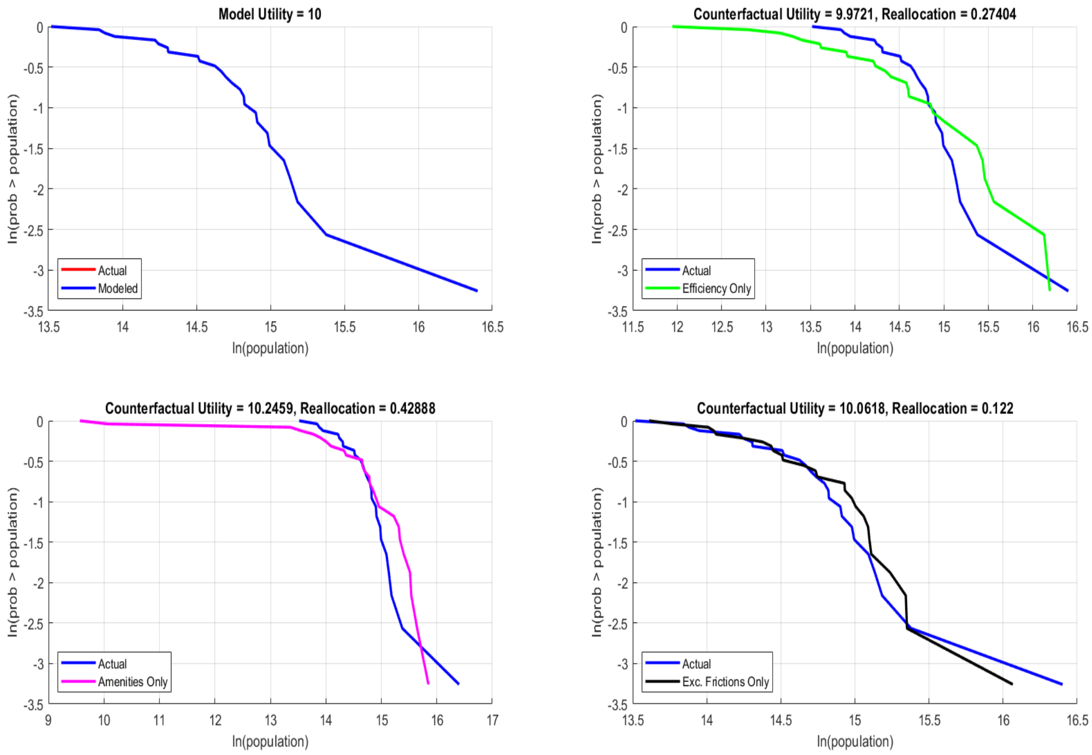


Figure 4. Counterfactual region size distribution with externalities when allowing the differences in only one characteristics.

would yield utility gain. In the U.S. case, the authors stated that overall welfare does not change due to these counteracting forces resulting from externalities. For example, while Istanbul's efficiency level is 50% more than the average, its efficiency level falls below 50% of the average with the inclusion of externalities. This is opposite for Gaziantep subregion. While its exogenous efficiency is 20% below the average, incorporating externalities increases its exogenous efficiency level to approximately 50% above the average.

The compounding impact of externalities on region-size changes is also prominent which explains the difference in population reallocation between counterfactuals with and without externalities. After including externalities in the model, cities with shrinking sizes mostly shrink more, and cities with increasing sizes have larger rise in their sizes. This is mainly due to the advantages resulting from externalities.

CHAPTER 5

CONCLUSION

In this thesis, I analyzed the relative importance of NUTS2-level region-specific characteristics (efficiency, amenities, and excessive frictions) for households' location choice and welfare using the spatial macroeconomic model in Desmet and Rossi-Hansberg (2013). Before moving into counterfactual analysis for Turkey, I first test the nature of the general equilibrium of the model to ensure its reliability with Turkish data. The regression and correlation analysis results suggest that the model is consistent with the data. I next run several counterfactuals to evaluate the importance of region-specific characteristics. There are two different counterfactuals in this study. The first one eliminates the differences in only one characteristic by setting its value to the population-weighted average. The second one allows the differences in only one characteristic by equating the other two characteristics to their population-weighted averages.

According to the results in the first exercise, the welfare gain exists for each characteristic, and the highest gain and population reallocation occur in the case of imposing average efficiency on all regions. The highest welfare gains for the U.S. and China in Desmet and Rossi-Hansberg (2013) are also obtained in the case of average efficiency, which indicates that efficiency has a relatively more crucial role in explaining welfare-maximizing allocations across regions. According to the results in the second exercise, except for the efficiency-only case, welfare gain still exists, and it is now higher than the gain in the first exercise. For the case of efficiency-only, there is a slight welfare loss amounting to 0.03%. The reason behind the subtle changes in welfare would be the fact that residents in Turkey already optimizes due to free mobility. Another reason may be that the shift in consumer behavior mitigates the negative impact of a change in regional characteristics.

It is the fact that production externalities also play a crucial role in determining population size, especially when we consider İstanbul. When the production externalities are included in the model, the resulting welfare changes in counterfactuals do not considerably differ from the case without externalities. This is potentially due to counteracting mechanisms behind this setup, which impede utility gain by making regions more alike and facilitating the gain by easing the adjustment of frictions.

The model is promising to be used for recommending and evaluating some policies for urban development; however, it is open to improvement as well. As the model has a homogeneity assumption for agents, adding heterogeneity to preferences or talents of agents would help us make advanced analyses and gain deeper insights into spatial dynamics in the Turkish economy.

APPENDIX A

TABLES

Table A1. Data at NUTS2 level for 2009-2011

NUTS2	N ('000)	Y (m$)	C (m$)	K (m$)	Hours (Annual)
TR10	13265.03	209759	85390	468250	1108
TR21	1534.223	17132	9328	42444	1200
TR22	1633.766	14550	8992	26003	1185
TR31	3927.463	43335	24034	95141	1078
TR32	2742.284	22691	162014	43151	1219
TR33	2963.067	23122	15521	49976	1148
TR41	3580.272	39297	22125	96984	1100
TR42	3251.607	39501	16847	99347	1164
TR51	4771.137	66805	32074	139391	1052
TR52	2247.862	15999	13504	27356	1201
TR61	2660.943	28784	13983	48292	1268
TR62	3737.661	26952	16565	50021	1066
TR63	2992.037	16944	12210	33137	1010
TR71	1498.905	9928	5901	15199	991
TR72	2342.552	17016	9962	31604	1001
TR81	1027.107	6675	5611	13150	1158
TR82	743.0007	5389	3172	7882	1203
TR83	2732.619	17401	10940	25793	1157
TR90	2518.602	16502	10402	26495	1436
TRA1	1067.833	6578	3260	9784	1190
TRA2	1142.354	4551	3261	4539	1011
TRB1	1638.442	9213	6849	13316	986
TRB2	2026.815	7323	5951	8816	869
TRC1	2417.02	12531	9472	26734	1072
TRC2	3202.758	12957	8242	19414	776
TRC3	2004	8803	3977	16448	841

Table A2. Correlation results between amenities estimates and the quality-of-life measures

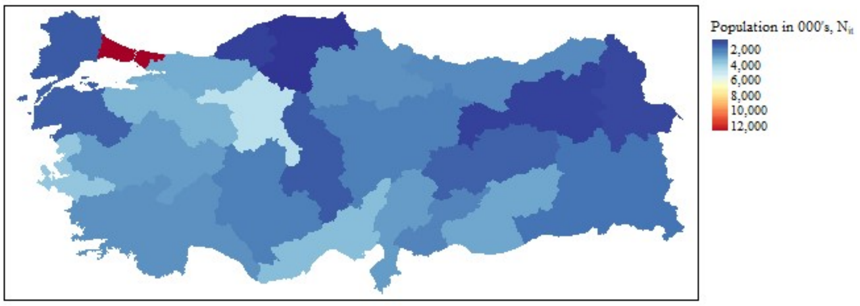
	Correlation	p-value	Expected sign
Türkiye'nin Şehirleri Sürdürebilirlik Araştırması			
Health	-0.8306	0.000	(-)
Culture&Art	-0.9087	0.000	(-)
Crime	0.5543	0.003	(-)
Education	-0.5489	0.003	(-)
Natural resources	-0.6162	0.000	(-)
Physical infrastructure	-0.9173	0.000	(-)
Küresel Rekabet Endeksi - Türkiye 26 Bölge - 81 İl			
Health	-0.7751	0.000	(-)
Tourism	-0.5884	0.001	(-)
Technological infrastructure	-0.8502	0.003	(-)
Education	-0.7488	0.000	(-)
Transportation	-0.7413	0.000	(-)
Physical infrastructure	-0.7787	0.000	(-)
Social life	-0.8485	0.000	(-)

Table A3. Estimated NUTS2 characteristics for 2009-2011

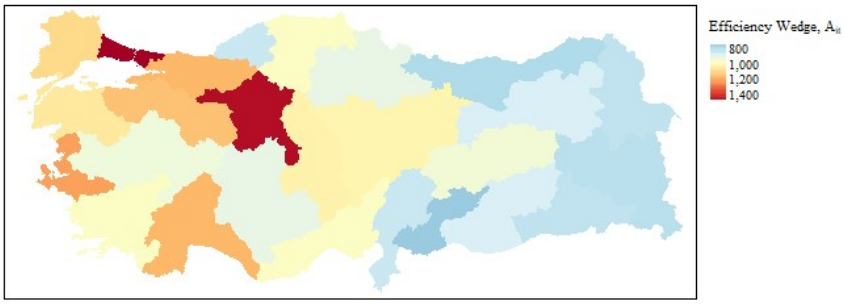
NUTS2	A_{it}	γ_{it}	g_{it}
TR10	7.341	0.227	-0.589
TR21	7.017	0.480	0.323
TR22	6.977	0.490	0.226
TR31	7.120	0.408	-0.086
TR32	6.888	0.522	-0.174
TR33	6.847	0.591	-0.101
TR41	7.065	0.452	-0.059
TR42	7.090	0.467	0.076
TR51	7.315	0.237	-0.112
TR52	6.829	0.527	-0.232
TR61	7.083	0.427	0.071
TR62	6.893	0.592	-0.105
TR63	6.749	0.687	-0.046
TR71	6.947	0.571	0.412
TR72	6.940	0.576	0.190
TR81	6.747	0.611	0.220
TR82	6.892	0.571	0.638
TR83	6.826	0.621	-0.022
TR90	6.673	0.669	-0.228
TRA1	6.783	0.691	0.559
TRA2	6.726	0.704	0.439
TRB1	6.858	0.603	0.255
TRB2	6.702	0.732	0.186
TRC1	6.621	0.754	-0.021
TRC2	6.785	0.727	0.118
TRC3	6.715	0.800	0.420

APPENDIX B

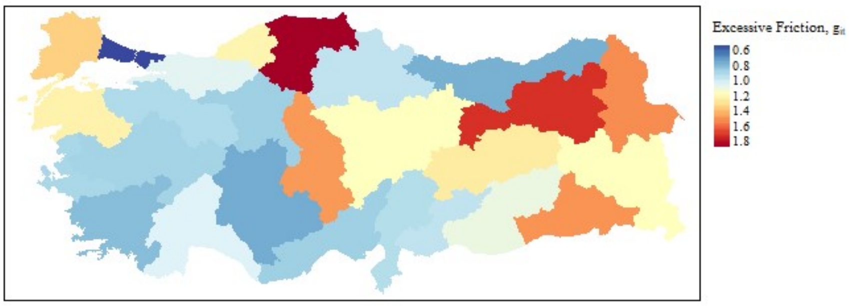
MAPS AND GRAPHS ON COUNTERFACTUALS



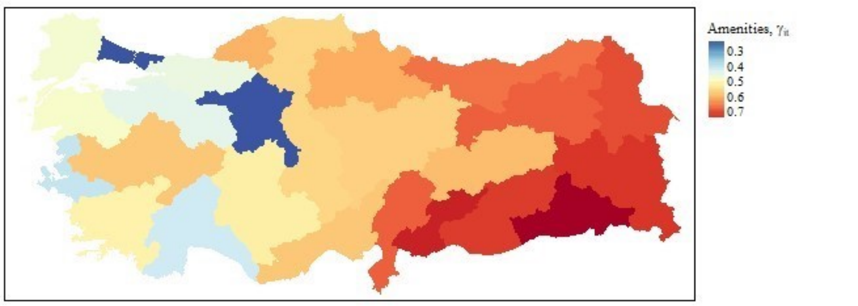
(a) NUTS2-level population distribution



(b) NUTS2-level efficiency wedge distribution

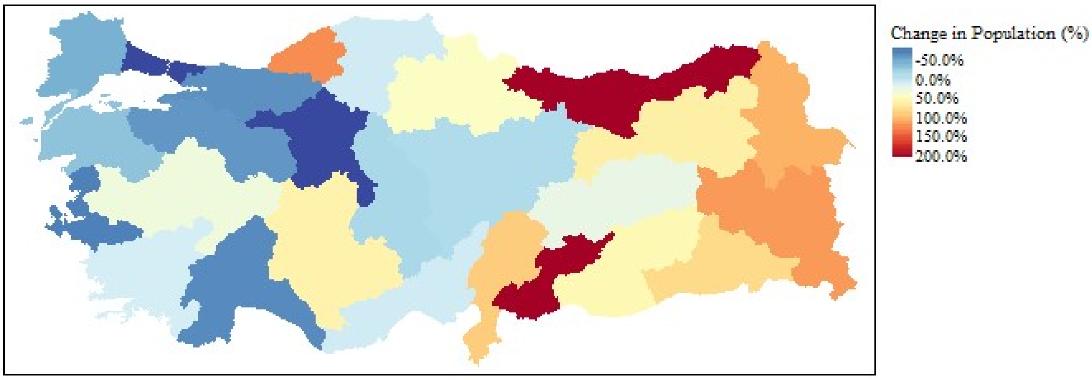


(c) NUTS2-level excessive friction distribution

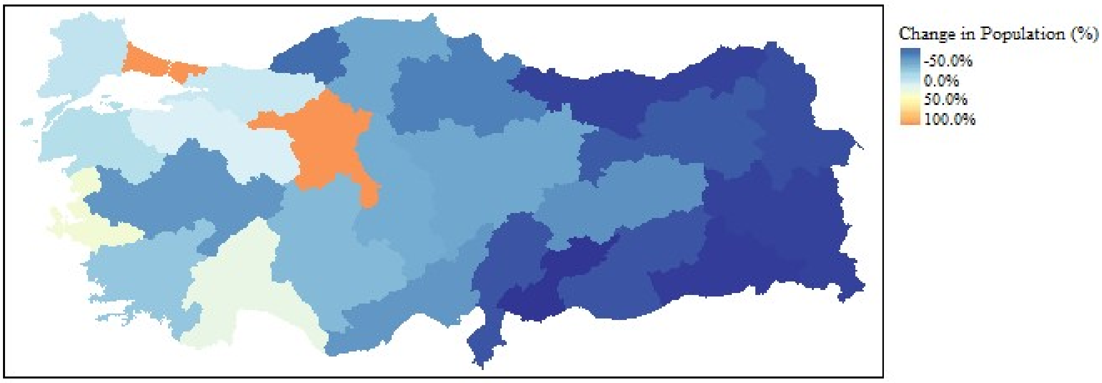


(d) NUTS2-level amenities distribution

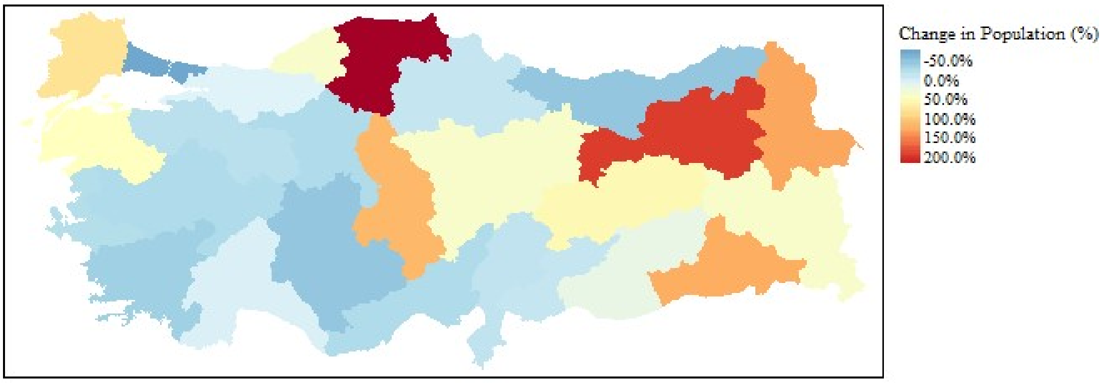
Figure B1. The Distributions of NUTS2 characteristics



(a) When eliminating the differences in efficiency wedge

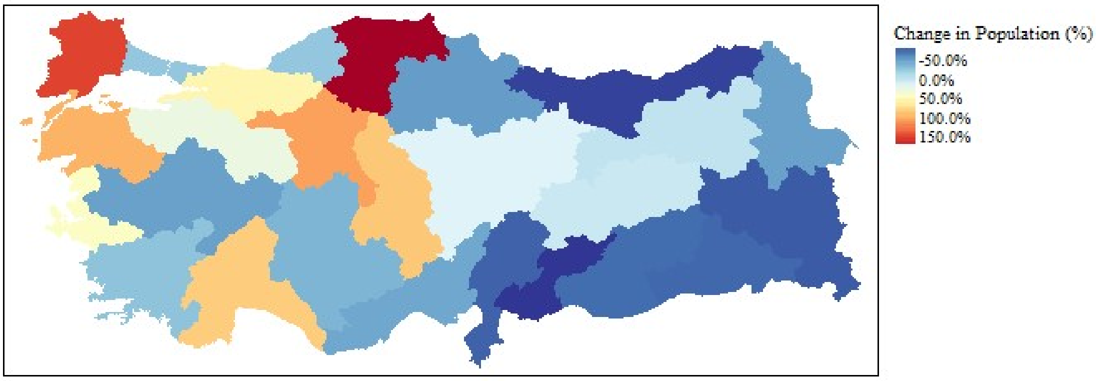


(b) When eliminating the differences in amenities

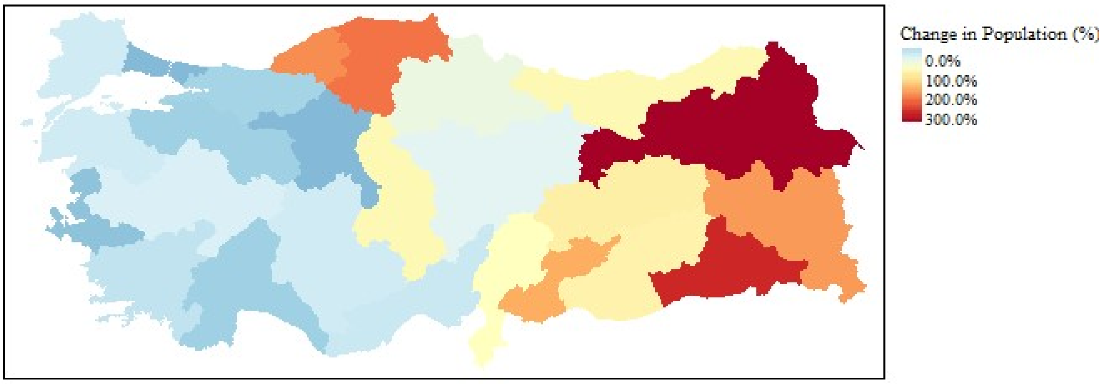


(c) When eliminating the differences in excessive frictions

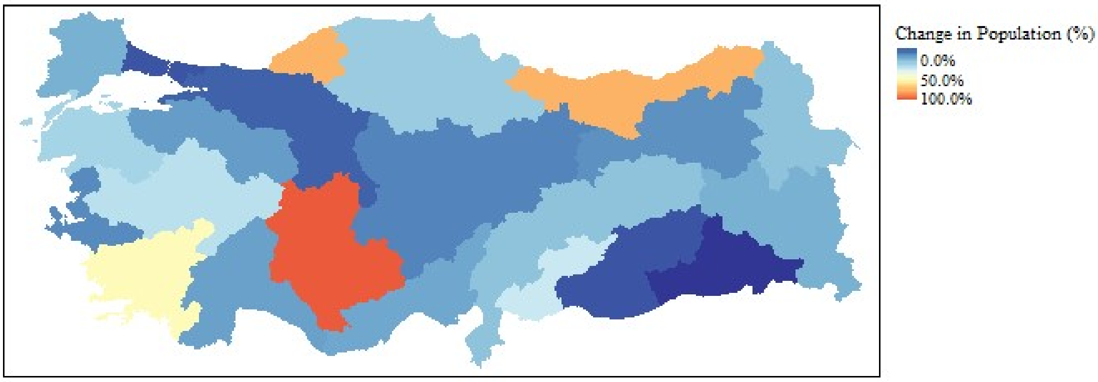
Figure B2. Population change (%) when eliminating the differences in only one characteristics



(a) When allowing the differences in efficiency wedge

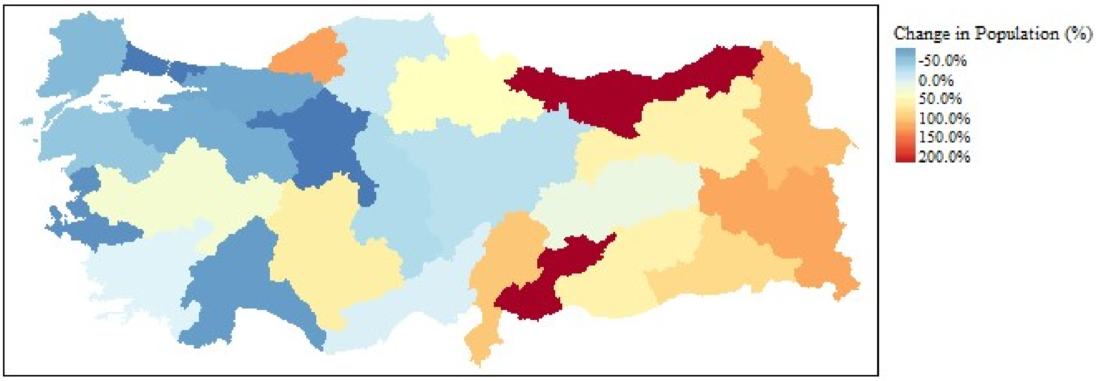


(b) When allowing the differences in amenities

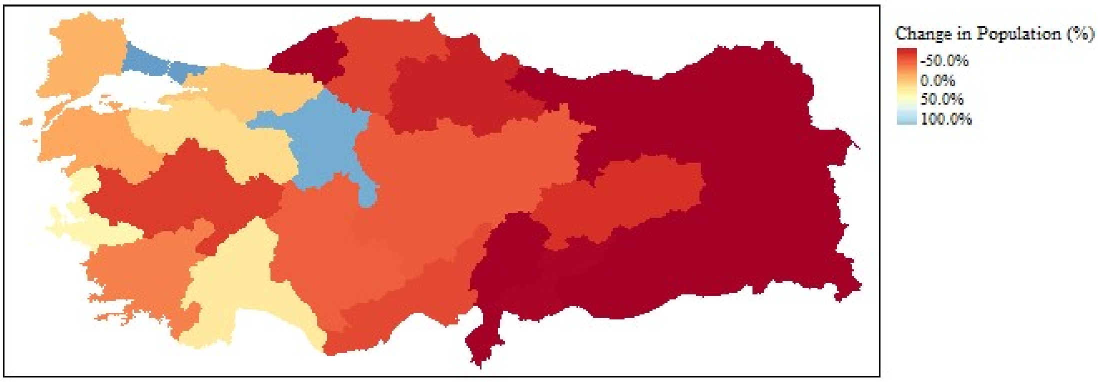


(c) When allowing the differences in excessive frictions

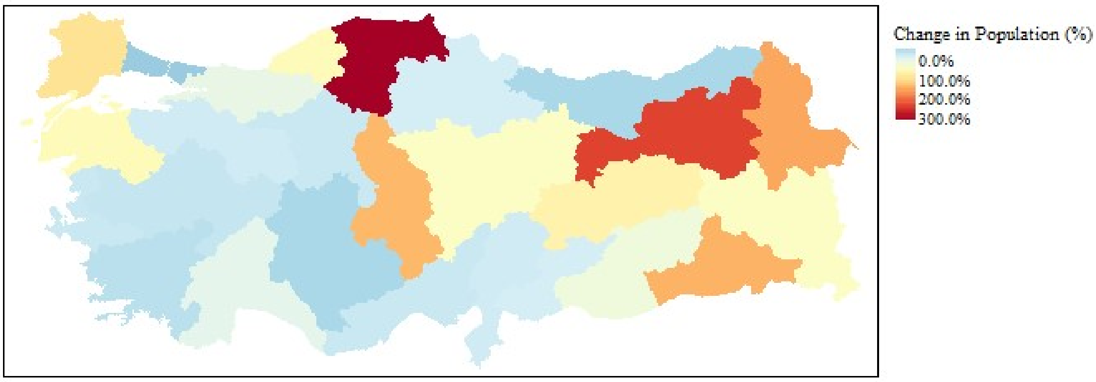
Figure B3. Population change (%) when allowing the differences in only one characteristics



(a) When eliminating the differences in efficiency wedge

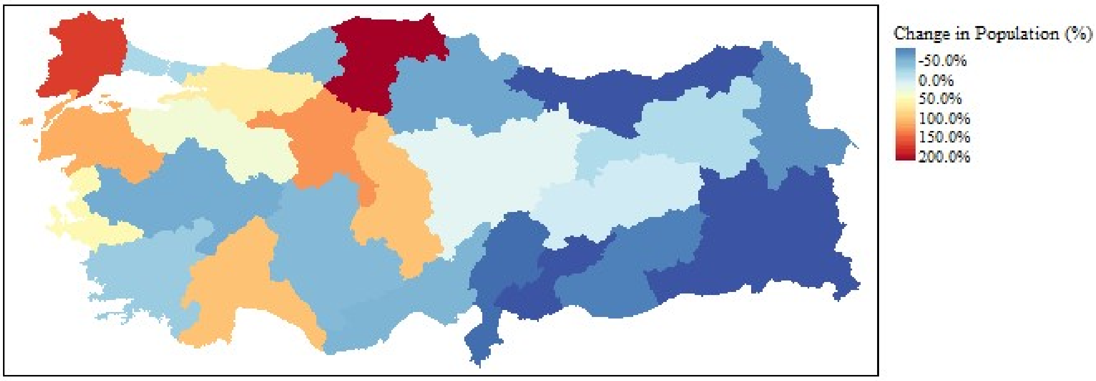


(b) When eliminating the differences in amenities

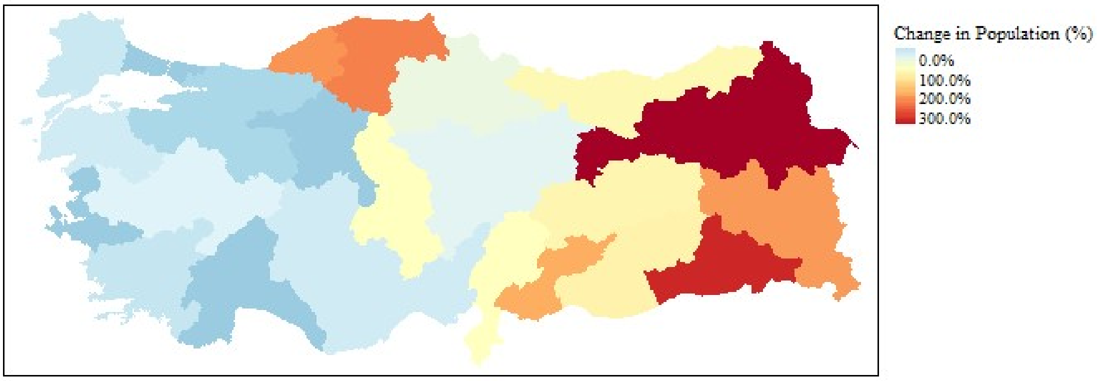


(c) When eliminating the differences in excessive frictions

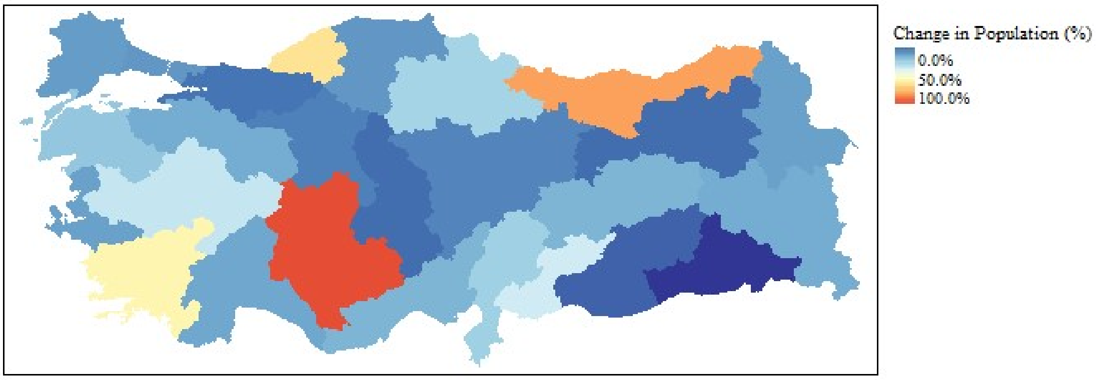
Figure B4. Population change (%) when eliminating the differences in only one characteristics with production externalities



(a) When allowing the differences in efficiency wedge



(b) When allowing the differences in amenities



(c) When allowing the differences in excessive frictions

Figure B5. Population change (%) when allowing the differences in only one characteristics with production externalities

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