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CONSTRUCTING A MULTI-REGIONAL SOCIAL ACCOUNTING MATRIX FOR TURKEY*

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Abstract

Regional impacts of public policies in Turkey have led to Regional Development Agencies and related institutions having responsibility for setting and achieving sustainability policies at the regional level. As a result, there is a significant interest in developing empirical models that can deal with the macro, micro and regional impacts of economic policies and interregional spillover effects. Spatial or Multi-Regional Computable General Equilibrium models are the most capable models to handle a wide range of policy relevant regional questions and the effects of policies on a comprehensive set of regional and national economic variables. However, an important ingredient in meeting the Multi-Regional CGE analysis is Multi-Regional Social Accounting Matrices. This study is focusing on the building the first Multi-Regional Social Accounting Matrix for Turkey with 11 regions and 8 sectors. We utilize from the most updated available datasets and implement the most conveninent non-survey methods which fit to data availability in Turkey.

Keywords: Input-Output Models, Computable General Equilibrium Models, Regional Economics

Jel Codes: C67, C68, R10, R13

1. Introduction

Computable General Equilibrium (CGE) models require comprehensive data to produce quantitative results. A Social Accounting Matrix (SAM) provides the underlying data framework for this type of models and analysis. A SAM includes both input-output and national income and product accounts in a consistent framework. This study provides a Multi-Regional Social Accounting Matrix for Turkey in a convenient format, which will enable modelers to construct Spatial or Multi-Regional CGE models. The format we explained here can be used to construct also for developing or underdeveloped countries which suffer from different kind of regional data.

The availability of regional employment data, interregional trade flows data and lastly TurkStat's various kind of regional data are permitting us to extend national level Social Accounting Matrix (SAM) to Multi-Regional SAM. This framework will enable us to analyze the impact of regional policies, i.e., from new infrastructure investments like airport and highway projects to the impact of unexpected events like eartquakes.

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Yeldan *et al.* (2012) try to examine Turkey via two large regions, i.e., west Anatolia and east Anatolia regions, and two sector Input-Output table and Social Accounting Matrix from national accounts. To best of our knowledge, a multi-regional SAM (MRSAM) for Turkey does not exist which has higher than two regions in geographic scope. So, the goal of this paper is to describe the steps to build a MRSAM constituting of 11 regions in Turkey. One can also disaggregate or aggregate regional decomposition according to needs. This paper dicusses the different data sources used and how the data were organized to build a MRSAM.

In the following parts, respectively, building process of national SAM will be described. Here, the true definition of government block in national SAM has a vital importance such a country like Turkey, whose public sector has a high share in the economy. A proper way, which is described at Telli *et al.* (2007) has been adopted to build national Turkish SAM. And lastly, regionalization process of national SAM, namely building the multiregional SAM will be dicussed. Here is the demonstration of interregional trade in MRSAM and their estimation brings a very convenient and appropriate way to regionalize the Social Accounting Matrix. The trade flows between different regions, which is necessary to compile multi-regional SAM has been estimated in accordance to a modified version of CHARM method (Tobben and Kronenberg, 2015).

2. System of National Social Accounting Matrix

Nobel Prize winning economist Richard Stone set forth the basic framework for the standardized System of National Economic Accounts (SNA) that is most commonly used around the world (Miller and Blair, 2009). According to Stone (1961), these System of National Accounts and Supporting Tables then worked as a bridge between statistics and applied economic analysis.

Conceptually, SNA framework takes us back to the notion of circular flow of economic resources in an economy. Because SNA includes not only economic production so as to display commodity flows between industries but also the flow of income associated with production. In the simplest way, there are firms that produce goods and services and household that purchase those goods and services in an economy. Household also works for the firms and receives income from them. At the end of the day, the whole income generated in the economy is exactly equal to expenditure in the economy. This is known as the fundamental tenet of the circular flow in an economy.

When the System of National Accounts (SNA) is combined with input-output accounts, which incorporate the inerindustry likages and also final consumption of the goods and services in the economy, the picture of the economy then becomes more comprehensive (Miller and Blair, 2009).

Consequently, SAM framework shows us a more comprehensive and disaggregated snapshot of the socioeconomic system of the country during a given year by extending the SNA and input-output framework and add a more detailed information about the roles of labor, household, firms, government and the other institutions or agents of the economy. It incorporates various crucial relationsips among variables which sometimes referred to as a “fully articulated” at the literature. Table 1 below presents a schematic SAM.

Table 1. Schematic National Social Accounting Matrix

	Activities	Commodities	Labor	Capital	HH	Firms	SSI	Govern.	D.Banks	Prv.Inv.	Pub.In.	ROW	Total
Activities		Domestic Production											
Commodities	Intermediate Use				HH Cons.			Public Consump.		Invest. Demand	Pub.Inv Demand	Export	
Labor	Labor Input												
Capital	Capital Input												
HH			Labor Income			Profit	Social Trans.	Social Transfer	Distrib. Profit			Remittances	
Firms				Capital Income				Subsidies				FDI	
SSI			SSI Premiums					Transfer for Deficits					
Govern.	Taxes on Production	Taxes on Products			Direct Tax	Factor Inc + Tax							
D.Banks					HH Saving			Interest Payment				Foreign Sources	
Private Inv.									Finance. to Inv.				
Public Inv.								Public Saving	Finance. to Inv.				
ROW		Import				Transf.		Interest Payments	Interest Payment				
Total													

As can be seen at Table 1, SAM is a square matrix in which account has its own row and column. Expenditures or payments are listed in columns and the receipts or incomes are in rows. The row sum of a given account must equal the column sum of the same account. So it means all expenditures must equal the receipt or income of corresponding account.

One of the most important difference at the formulation of a SAM is the distinction between production activities and commodities. Production activities produce different goods and services by buying raw or intermediate goods and services from commodity account. Also activity accounts pay production taxes to the government and the remain portion, value added, distributed to labor and capital. Sum of the sectoral value added and intermediate use gives us total domestic production by sectors, i.e., row total of domestic output which commodity accounts get it from production accounts. Commodity account will pay product taxes to government. And also, commodity account will demand goods and services produced in foreign countries. They will pay to import sector for this transaction.

SAM framework also distinguishes the role of household. At least one household account is necessary for a SAM but one can also disaggregate the household account according to education or income level etc. and it is not only final demander in an economy but also as a provider of labor, i.e., value added factor production. So, this expansion results in an additional row and column which labeled Households. This account will get a factor income (labor conpensation less social security premiums) from labor account, as weel as profit from firms, pensions from SSI, social transfers from government, interest income from domestic banking sector and remittences from the family members in abroad. Household will spend this income to different sectors in commodity account, pay direct taxes to government and save the rest amount.

Firms earn capital income from capital account and get subsidies and transfers from government and transfers from rest of the world. This income is distributed to housholds as a profit and some part of it goes to government as direct taxes and as well as public firms' profit as a factor income.

We need to emphasize something here about government account. The government here is distinct from administrative public activities which are included in the production activities' account. These public activities are included in the service subsector of activity accounts. The government account here allocates its current expenditures on buying goods and services from commodity sectors and as well as transfers to household, subsidies to firms, transfers to SSI and interest payments to domestic banking and also rest of the world. The remaining of the government income is the saving which goes to public investment. On the other hand, government collects the production and product taxes (which also includes tariffs) from activity and commodity accounts, direct taxes and factor income from households and firms. Government account closes when raw and column sum equals each ather. By following Telli *et al.* (2007), we also added social security instiution to Turkish SAM. This account will channel social security funds into government and to households as a mere intermediary.

Domestic Banks account, just like in SSI account, here functions as an intermediary and channels flow of funds among institutions. In our settings, Domestic Bank account gets the household savings and governmets intereset payments as an income and allocates the resources to private investment, to public investment for the deficit part of the public budget and also pays to household as a distributed profit and interest of foreign debt. All of these flows reflect the fashion in investment-saving relation in Walrasian economy. Investment accounts spend available funds to investment goods. And lastly, Rest of the World (ROW) account describes the relations with exterior world.

At the end of the day, Multi-Regional SAM needs so many data from different sources. The first procedure here is to build a national SAM and then disaggregate the national SAM using the published regional datas, which will be explained in the following part. The structure of the national SAM is already shown in Table 1.

2.1. Data Needs of Turkish National SAM

To build a national SAM wich has these different networks of the same economy explained above, one needs to unify closly related balances of the economy and collect the related datas. These accounting types can be classified into three main frameworks. First main part is input-output tables. These tables exibit inter-sectoral flow of goods and services in the economy. Secondly, national balance sheets, i.e., Public Sector Borrowing Requirement Table, show real and nominal assets and their distributions. And lastly, Balance of Payments exhibit exchange of all goods and services with exterior world and borrower and lender relations in an economy. SAM unifies these three main part and generate a more general picture of the economy.

These three main framework will categorize the procedure of compiling a national SAM for Turkey. Datasets needed to compile the SAM are shown in the Table 2 below.

Table 2. Data Sources of Relevent Accounts

Commodity and Activity Accounts	2012 Supply and Use Tables in basic prices (TurkStat, 2016a) 2015 GDP by kind of economic activity, income approach (TurkStat, 2016c) 2015 Institutional Sector Accounts (TurkStat, 2016f)
Factor Accounts	2012 Input Output Table (TurkStat, 2016e) 2015 GDP by kind of economic activity, income approach table (TurkStat, 2016c) 2015 Work Place and Insured Person Statistics (Social Security Institution, 2015)
Institutions	2012 Input Output Table (TurkStat, 2016e) 2015 GDP by expenditure approach table (TurkStat, 2016d) 2015 Institutional Sector Accounts (TurkStat, 2016f)
Public Accounts	2015 Public Sector Borrowing Requirements Table (Ministry of Development, 2017)
Social Securty Account	2015 Work Place and Insured Person Statistics (SSI, 2015)
Foreign Balance	2015 Balance of Payments 6th Handbook (Central Bank of Turkey, 2017)
Foreign Trade Accounts	Commodity Composition of Export Table (TurkStat, 2016b) Imports by ISIC Rev. 3 Table (TurkStat, 2017)

The commadity and activity accounts in the national SAM are derived from aggregations of the commodity and activity accounts in the national SAM. In our framework, Turkish MRSAM has 8 broad aggregated-commodities and activities. These are agriculture, food processing, textile, machinery, construction, transportation, other industries and lastly service sector. The institutions in our context consist of household, enterprises, government, domestic banking and social security institution. Now, we can start to define the building process of three main blocks of national SAM.

2.2. Balance of Supply and Demand / Income and Expenditure Side

The first key table of SAM accounts is the so-called “USE” table, which provides information on the consumption or use of commodities by industries and final demand agents. Column of this table indicates demand of intermediate goods and rows indicate the use of these commodities by industries.

The second key table of SAM is the MAKE table. The transpose of this table refers to supply matrix in practice. This table provides information on industry production of commodities. Columns of MAKE table corresponds to a commodity and rows correspond the production of that commodity. At the end of the day, industries use commodities to make commodities. It is commodities that are the inputs to industrial processes and that are used to satisfy final demands (Miller and Blair, 2009). The components of final demand sectors in this study are household expenditures, government pruchases, private investment, public investment and finally export of goods and services.

Finally, the final demand and value added sectors in input-output tables can be viewed as somewhat exogenous to the more closely interrelated system of industrial sectors (Miller and

Blair, 2009). The income catagories comprising value added inputs to industries include wages and solaries paid to labor, profits to capital and taxes to government.

Consequently, one of the main part of SAM, i.e., demand and supply parts, will be based on 2012 Input-Output Tables (TurkStat, 2016a). Input-Output (I-O) table will serve us to calculate intermediate demand shares, value added shares, tax shares and final demand shares for some economic agents in the economy. So, I-O table is the key table to build a SAM for the year 2015, which will be base year our SAM.

To calculate the intermediate good consumption by industry, one needs to calculate technical coefficients (a_j) of related industry. These coefficents basicly related with the shares of intermediate goods (z_j) and value added components of total output (x_j) at the related industry. And the technical coefficient can be computed by the foolowing way:

$$a_j = \frac{z_j}{x_j} \tag{1}$$

These coefficients then will be used to find intermediate consumption and value added by industry for the year 2015. And total intermediate consumption of the economy in 2015 is 2.059 billion TL according to Institutional Sector Accounts (TurkStat, 2016f). Value added and taxes less subsidy by kind of economic activity (NACE Rev. 2) data (TurkStat, 2016c) is used to calculate 2015 values of related accounts. In our national SAM, manufacturing sector is disaggregated by using 2012 I-O shares to find textile, food processing and machinery industry.

2.3. Balance of Public Sector Side

After we calculate the government expenditures and investments by sectors, Public Sector General Equilibrium (PSGE) table, currently prepared by Ministry of Development, will constitute the basis of the remaining public side of the SAM. PSGE table defines public sector revenues and disposable income and also addresses of this income, which is used for government consumption, investment and transfers to household and firms. Table 3 below presents the aggregated version of Turkish PSGE, which is generated by Ministry of Development on annual basis.

Table 3. Public Sector General Equilibrium Table for 2015 (in millions TL)

1. REVENUES	514.6
A.Tax Revenue	
Direct + Indirect	403.1
B. Non Tax revenues	42.4
C. Factor Income	69.1
2.EXPENDITURES	
A. Social Funds	-16.3
B.Transfers	-176.4
Public disposable income (1-2A-2B)	321.9
C. Current Expenditures	-236.1
public saving (1-2A-2B-2C)	85.9
D. Public Investment	-95.4
Saving/investment Balance	-9.5
E. Capital Transfers	11.01
F. Stock Changes	-0.672
Public Sector Borrowing Requirement	-0.8

This table enables a proper way to build real size of the public sector over the economy. The key variable here is public saving. As seen, one can calculate that substructing social funds, transfers and current expenditures from governments total revenues. In 2015, public saving is

85.890 billion TL. This value is equal to public investment which is directly financed by government itself. The difference between public investment and public saving gives us the Public Saving-Investment Balance. There exists a deficit in this balance (9.533 billion TL for 2015). In 2003, this deficit has been reached to its peak, 35.553 billion TL and it decreased substantialy with a better administration in public finance sector. Public Saving-Investment deficit will be financed by Domestic Banking account in the SAM framework.

Social Funds in PSGE table shows the net income of social security institutions, which namely is proper revenues from social security incomes collected, over the social security expenditures incurred by those institutions. The deficit of Social Security Institution is 16.276 billion TL in 2015. This amount will be transferred by government to equilibrate the income and expenditures of SSI account in the SAM. Social security premium payments and SSI pension payments and health benefits are taken from Work Place and Insured Person Statistics (SSI, 2015). Labor account will give social security taxes to SSI; and SSI will allocate the social benefits to household in the SAM framework.

Current transfers transfer in PSGE table will be allocated among households, enterprises, domestic banks and rest of the world. Firms will get transfers in the nature of production subsidies from government, which also link PSGE flows with input-output and national income accounting system. Subsidies by sectors data are available at GDP by kind of economic activity tables, which is calculated by income approach (TurkStat, 2016). Domestic Banks are paid for government domestic interest bearing assets. Also, rest of the world account at our SAM setting receives foreign interest of public sector. Balance of payments accounting for the interest cost of public sector is the main source that we will already describe in details at the next section. Household transfers in this setting gets simply a residual from total current transfers.

On the other hand, government revenues in the SAM framework are classified as revenues those levied either on production and products indirectly or on enterprises and households directly. Productive sectors incur taxes on production or activities whereas commodity account pays taxes on products, which include sales taxes and import tariffs to government account in SAM. Taxes on production and taxes on products (in total) data are taken from Institutional Sector Accounts (TurkStat, 2016c). These total tax values are disaggregated according to information in 2012 Input Output Table and GDP by kind of economic activity, income approach table (TurkStat, 2016c). The important point here needed emphasizing is that taxes on production is not calculated taxes less subsidies. Subsidies will assign separetly in Government Transfers to Enterprises account.

Enterprises pay gross factor income and corporate taxes to government account. Total public sector factor income for 2015 is 69.103.877 TL. In SAM, government account will acquire factor income from enterprise sector. However, PSGE table does not contain some tax breakdowns, such as corporate taxes. Direct Tax definition in PSGE table contains both income and corporate taxes without any explicit relevant line items. One needs to disaggregate these two.

2.4. Foreign Balance Side

Rest of the World (ROW) account constitutes the balance with exterior world. Two important parts of this account are export and import accounts. Totals of these two accounts are taken from Balance of Payments (Central Bank of the Republic of Turkey, 2017). Their breakdowns by sectors (ISIC rev 3) are available (Turkstat, 2016b).

Payments to rest of the world contain import and institutional payments. Enterprises pay interest for foreign resources held, make profit transfers to abroad and government pays foreign interest also. Debt service data utilized here comes also from Balance of Payments (Central Bank of the Republic of Turkey, 2017). One needs to calculate interest payments and icomes for both private sector and public sector separately from sub accounts of Balance of Payments, i.e., primary income and financial account of BoP. Private sector interest payments is the sum of short term and long term interest payments by banks, Central Bank of the Republic of Turkey and other sectors. This data also comes from Loans subsector of BoP. Firms' profits transfer to abroad data correspons to direct investment "debit" in primary income sub-account of BoP.

On the other hand, household receives remittences and enterprises get entrepreneur income and intereset income from abroad. Unrequited transfers and workers' remittences data are also taken from Balance of Payments. And lastly, firms' foreign currency income is based on a residual of exterior sources after all institutions earn incomes and incur foreign exchange expenses. Table 4 shows our calculation of income and spending side of ROW account.

Table 4. Balance of ROW Account (in millions TL)

ROW Income	560.3
Export	545.4
Remittences	2.6
Firms foreign currency income	11.1
Unrequited Transfers	1.3
ROW Payments	643.2
Import	606.8
Private Sector Interest Payments	25.1
Firms' Profit Transfers	9.7
Public Sector Interest Payments	1.6
Foreign Savings	82.9
ithalat	606.8
ihracat	545.4
Net Factor Income	-22.8
Unreqited Transfers	1.3

So far, all accounts are closed step by step according to an order. The last thing is to calculte savings in the economy. The breakdowns of balance of ROW account table above is also very important to find Gross National Income (GNI), which will be used as a satellite account.

GNI shows the total domestic and foreign output claimed by residents of a country. So, it is extended version of GDP and this extention includes the Unrequited Transfers and Net Factor Income from Abroad. It can be identified like the following formula:

$$NI = C + I + (X - M) + NFI + UT \tag{2}$$

And if we make an arrangement like below,

$$GNI + (M - X - NFI - UT) = C + I \tag{3}$$

Equation 3 gives the sources of the national consumption and investment, which also represents the domestic absorption. Left hand side of the equation shows respectively domestic sources and foreign sources. Part in brackets on left hand side, foreign sources, is exactly equal to the volume of Current Account balance in the Balance of Payments.

At the classic GDP framework, total foreign resource is only equal to foreign trade deficit, i.e., $X - M$. However, when we extend the definition of national income from GDP to GNI, total foreign savings or resources will be equal to Current Account deficit rather then trade deficit. We need to note that, when we extend the scope of the definition of national income from GDP to GNI, total resources available for domestic capital formation or consumption do not change. Only the weight of domestic or foreign sources (savings) of that domestic absorption is financed differs. So, one needs to use GNI definition to calculate an accurate private disposable income and private savings. We already know that saving is the linear distance between income and the amount of income that is consumed ($S = Y - C$).

Since both government and household saves in the economy, total saving constitutes of public saving (S_g) and prviate saving (S_{hh}). One can calculate the household saving by substracting public saving from total saving which is calculated like above.

Last step of the procedure of building national SAM is to equalize the row and column sum of the national SAM. As seen above, constructing a SAM necessitates so many datasets from a variety of sources, which is also including data from prior years. These differences cause one to get unbalanced row and column sums in national SAM. There exists various kind of methods to solve this problem in the literature.

RAS approach, which is mostly used, requires that we start with a consistent SAM for a particular year and update it for a later year given new information on row and column sums (Robinson *et al.* 1998). On the other hand, Robinson *et al.* (1998) extend Cross Entropy method to the RAS method by proposing a flexible approach to estimate a consistent SAM starting from inconsistent data estimated with error, a common experience in many countries, which is also used in this study.

3. Regionalization

Regional information from the regional SAMs is retained for the commodity, activity, factor (labor and capital), enterprise and regional household. The accounts for government, social security, and investment accounts present national level information. Each regional SAM contains one regional household, enterprise, labor and capital accounts. Government, Invesment and SSI is in the country level and they interact with each of our regions in our multi regional SAM. The interregional trade flows depict between which two regions the trade is taking place.

The geographic decomposition of the Multi-Regional SAM will constitute of 11 regions. Regional statistical system of TurkStat follows European Union Nomenclature of Territorial Units for Statistics (NUTS) system. Regional decomposition constitutes of aggregation of NUTS 1 regions except biggest three cities; Istanbul, Ankara and Izmir. Regional decomposition of our Multi-Regional SAM can be seen at Table A1.

In order to generate Multi-Regional SAM, one needs to use various data from different sources. However, existing data sets are not sufficient to construct the MRSAM based on a fully survey data. According to Hewings (1985), one way to do this is to conduct a survey, which covers sufficiently large sample of the regional industries. This common problem in this field gives rise to numerous non-survey methods to generate regional IOTs based on combinations of regional indicators and national datasets. So, the first procedure was to build a national SAM, which is explained in the previous part, and then disaggregate the national SAM using the published regional datas.

In the literature, there are many examples of regionalization of national tables for single or multiple regions. The regionalization can be performed by different nonsurvey methods such as Location Quations (LQ), RAS, Cross Entropy (CE), Supply-Demand Pool or Commodity Balance (CB) etc.

Even the family of Location Quatients (LQ) methods has many members. Simple Location Quotion (SLQ) is one the most used in many regional studies. The other member of this family are Cross-Industry Quotient (CIQ), developed by Schaffer and Cu (1969); Purchase-Only Location Quotient (PLQ), developed by Consad Research Corporation (1967); the semilogarithmic Quotient and its variants FLQ and AFLQ, developed by respectively Round (1972) and Flegg *et al.* (1995).

Lahr (1993) argues that only the LQ and CB methods should be regarded as “true” nonsurvey method. These two methods will be explained shortly. Then, we will continue from the method, Commodity Balance, we used in this study.

LQ methods are based on the assumption that each regional input-output coefficient $a_{i,j}^{r}$ is related to its national counterpart $a_{i,j}^{n}$ in the following way:

$$a_{i,j}^{r} = t_{i,j}.\, a_{i,j}^{n} \tag{4}$$

The term $t_{i,j}$ here is the regional purchase coefficient and its value exactly depends on the location quation. Mathematically, LQ_i can be defined as

$$LQ_i^r = \frac{x_i^r / x^r}{x_i^n / x^n} \tag{5}$$

The numerator indicates the proportion of region r's total output that is contributed by sector i. On the other hand, the denominatior represents the proportion of total national output that is contributed by sector i in national level. Namely, this method tells us the sector i's representation in the relevant region. If the LQ_i is smaller than one, $t_{i,j}$ is equal the LQ_i^r. If the location quation for the relevant industry is grater than or equal to one, it means that region is self sufficient in the relevant sector and $t_{i,j}$ is equal to one and consequently $a_{i,j}^r = a_{i,j}^n$.

In this fashion, self sufficient sector in the region has the national technical coefficient but the other regional sector which has smaller capacity is being to punished by lower technical coefficient which equals the LQ_i^r.

An alternative nonsurvey method is Supply-Demand Pool or Commodity Balance approach, based on the work by Isard (1953). The regional commodity balance is the difference between regional output and the sum of intermediate demand, final demand and net export of region. Commodity balance can be stated as the following formula:

$$CB_i^r = (x_i^r + m_i^r) - (z_i^r + fd_i^r + e_i^r) \quad (6)$$

First thing first, to compute regional CBs, one needs to find regional output of each sector and total regional intermediate demand. National intermediate demand data is available at Institutional Sector Accounts (TurkStat, 2015). Regional breakdowns of intermediate demand of sectors will be estimated from regional employment data (SSI, 2015), assuming that labor productivity in different regions of Turkey are equal to national average. In recent years, Social Security Institution in Turkey has undergone major changes and three different segments of the institution (Bagkur, SSK and Emekli Sandigi) have merged. Informal employment also decreases day by day. The scope of the employment dataset still covers these three segments of SSI, i.e., labor force in public sector (Emekli Sandıgı or 4/1c), voluntarily insured people (Bagkur or 4/1b) and compulsory insured people (SSK or 4/1a). Compulsary insured people dataset is the vital part of employment datasets. It covers employment data in NACE sectoral level for each city. We added the public employment to service sector in each city. And lastly, voluntarily insured people data (Bagkur) covers two sectors, agriculture and others. We allocated voluntarily insured people in the "other" sector to the sectors in our MRSAM after we added agricultural employment of voluntarily employed people to agriculture sector. After these corrections, we can start to build our MRSAM.

Table 5. Demonstration of Multi-Regional Social Accounting Matrix

	Industry	Commodity	Factor	Institution	Industry	Commodity	Factor	Institution	Industry	Commodity	Factor	Institution	Total
Industry													
Commodity													
Factor													
Institution													
Industry													
Commodity													
Factor													
Institution													
Industry													
Commodity													
Factor													
Institution													
Total													

Diagonal parts of the generic MRSAM demonstrated at Table 5 above are different regions. Each grey shaded area at the Table 5 represents the regional commodity and income balances. Dark grey shaded areas demonstrate the trade between regions. As seen, the form of interregional commodity flow between regions are from commodity to commodity account. One of the biggest advantage of this demostraiton in MRSAM setting is to avoid from complex trade relation between economic agents in the economy, i.e., industries intermediate demand from other regions or regional households' demand from other regions' commodity market etc. In this way, we assume that regional commodity demand/supply from/to other regions will be met by the commodity pools. At the end of the day, this form will enable commodity balance in the regions.

Generation of regional input-output tables consists of a sequence of steps based on national Social Accounting Matrix, which is explained in previous part, and regional account datasets. The main approach here is to incorporate superior information in the most efficient way like in the following steps of generation of our MRSAM.

3.1. Production Block

Regional intermediate demand can be estimated by:

$$z_i^r = \frac{L_i^r}{L_i^n} z_i^n \tag{7}$$

So, the weight of regional employment in sector i over national employment level at the relevant sector will be used to calculate regional intermediate demand of i (z_i^r). Here, z_i^n denotes the national intermediate demand of the same commodity, which already introduced in the national SAM.

After we get the regional total intermediate demand by sectors, it is easier to calculate used inputs or intermediate demand matrix (Z). We assume that regional and national input requirements are identical, namely there is no difference between regions in term of input needed to produce one unit of output. So, the input requirements of regional sectors can be calculated like the following formula:

$$z_{i,j}^r = a_{i,j} z_i^r \tag{8}$$

Technical coefficient here, $a_{i,j}$, is defined as the amount of input i that the economy uses to produce one unit of output i. and the technical coefficient can be computed by the foolowing way:

$$a_{i,j} = \frac{z_{i,j}}{z_i} \tag{9}$$

Equation yields an estimate of interindustry transaction matrix (Z^r) for each region. Once this is known, total regional output by sector is just the total of column sum of regional intermediate demand and primary factor demand.

Primary factor demand for each region, i.e., labor and capital, will be calculated via our satellite accounts. It is the regional GDP datasets. Regional GDP datasets (TurkStat, 2016i) will serve as an anchor to calculate a better regional labor and capital values for relevant sectors in regions. From the income side, Regional GDP will be the sum of "compensation of employments" which will go to labor as income, "operating surplus" which will go to firms as profit and "net taxes on procution". This dataset is available in sectoral details for each city (TurkStat, 2016g and 2016i). However, sectoral details include only the main sectors in the economy, i.e., industry, agriculture and service sectors. One needs to do necessary calculations to disaggregate sectoral decomposition. Here, we used again employment data as a location quation to disaggregate the sectors in region.

3.2. Final Demand Side

These sub-tables may be broadly classified into MRSAM core accounts and satellite (auxiliary) accounts. The core accounts, i.e, intermediate demand, domestic production, final demand accounts by region and economic branch etc., are those which appear in the final MRSAM. These accounts explaind in the previous part.

The most important regional satellite account which will serve as a control-totals for the core accounts, is Regional Gross Domestic Product. This satellite account does not appear in the final MRSAM, but it is the sum of the regional investment, regional consumption and regional net export (both foreign and domestic). Regional GDP data is available at even city level (Turkstat, 2016g). Regional GDP will also include the interregional trade in the economy as in following formula.

$$GDP_i^r = HHC_i^r + GovC_i^r + PrivInv_i^r + PubInv_i^r + (Ex_i^r - M_i^r) + (DomEx_i^r - DomM_i^r) \quad (10)$$

Household consumption data is available in regional level. However, sectoral classification does not fit to sectoral decomposition of IOTs. Since people more or less consume same kind of goods, the total value of regional household consumption is more important than sub division of this consumption in regional level. So, regional total household consumption (1.44 billion TL in 2015) can be calculated as the following fashion:

$$HHC^r = {DI^r}/{DI^N} \, .HHC^N \quad (11)$$

We assumed that fixed share of income consumed in all regions and then, national shares in household consumption account used to calculate bearkdowns of regional household consumption by sectors. Regional disposable household income (DI^r) dataset and regional population in household level are available (TurkStat, 2016h).

On the public side of final demand, public expenditures and public revenue datasets for the local and central government at the city level are available (Ministry of Development, 2016). Scope of the public expenditure datasets contains also interest payments and capital formation. One needs to adjust these tables to reach more accurate city level public expenditure totals. If interest payments and capital formation are neted out from the total public expenditure for each city, we get the total public expenditure levels for each city. In addition, these totals will be defined as the portion of national public expenditure by sectors in each region of MRSAM. It can be seen at Table 6, regional percentages of total 324 Billion TL government expenditures in 2015.

Table 6. Regional Public Investment Shares

Istanbul	17%
Marmara	12.60%
Izmir	5%
Aegean	6.20%
Ankara	13.60%
Central Anatolia	7.50%
Mediterranean	11.60%
Soth East	9%
East Anatolia	7.80%
West Black Sea	5.60%
East Black Sea	3.70%

Source: Authors calculation based on Ministry of Development (2016).

Public investment data is another available data in regional level provided by Ministry of Development on annual basis. The scope of investment data provided by Ministry of Development are for each institutional breakdown of public service sector. One needs to dissaggragate and calculate investment total according to the sector of related instiutions. For the sake of consistency, we did some corrections which will equalize the sum of regional sectoral investments to national sectoral investment totals. Regional public investment of sectoral breakdowns can be seen at the following figure.

Regional private investment for each sector will be obtained being simply a residual from our regional GDP satellite account. One needs to set up regional household and government expenditure by sectoral breakdowns, regional public investment for each sector and regional foreign and domestic trade, i.e., export and import to ROW and other regions in Turkey. Then, regional private investment can easily be obtained from regional GDP equation. But before obtaining regional private investment, we need to know regional foreign trade data and interregional trade within the country.

Regional export and import datasets are available in regional level by three main sectors, i.e., agriculture, industry and service sectors (TurkStat, 2016b, 2017). Turkish Exporters' Assembly (TEA) publish sectoral export performance of cities tables in monthly and annual basis. One needs to use these datasets to get sectoral decomposition of TurkStat'regional export data in industry sector. Since there is a calculation difference between TEA and TurkStat, we prefer to use TEA sectoral breakdowns of export to disaggregate industry data in TurkStat. On the other hand, for the regional import account, there is no alternative data to decompose sectoral breakdowns. We here used the employment shares in regions to further disaggregate the import of industry sectors.

Lastly, interregional trade flows are the key part of MRSAM tables. Interregional trade flows are treated as an export and import from a region of origin to destinatination region in the framework of MRSAM. However, interregional trade flow data is not available in many countries. This is seen one of the reasons which make it harder to make analysis in multi-regional basis. However, one of the most important improvements in terms of regional data is the availability of interregional trade flows (Ministery of Science, Industry and Technology, 2016). Even if these data sets do not contain sectoral breakdowns, firstly, this valuable dataset will serve to obtain regional private investment by sectors which is calculated as a residual from regional GDP satellite account. And secondly, this dataset will guide us to calculate regional trade flows by sectors.

3.3. Interregional Trade Flows: Off Diagonal Part of the Multiregional SAM

The key feature of Multiregional Social Accounting Matrix is to enhance single region models in terms of geographical decomposition. The relation between different regions in economic terms occurs via the flows of goods and services between different regions in a country or a group of countries. So the off diagonal part of the MRSAM constitutes of trade and factor flows between economic agents in different regions.

Since data on the regional trade flows are only available as totals of interregional trade, a convenient method will be used in this study to compute regional trade flows between regions. In our context, two main sources will trigger the interregional trade. First one is Commdotiy Balance in the region (Isard, 1953) based on the principle of maximum local trade, i.e., "if commodity i is available from a local source, it will be purchased from that source" (Harrigan *et al.* 1981). Second one is the cross hauling which we will descripe in details.

The first task is to calculate regional commodity balance of each sector in each region and regional commodity balance can calculate as in the following formula:

$$CB_i^r = (x_i^r + m_i^r) - (z_i^r + fd_i^r + e_i^r) \tag{12}$$

where x_i^r denotes total domestic production or output of sector i in region r and m_i^r denotes imports in region i, these two together indicate regional supply. Second part of the right hand side indicates the total demand in the region where z_i^r denotes regional total intermediate demand, fd_i^r and e_i^r denote final demand and export in the region respectively. At the end of the day, if commodity balance in a region has a negative value, i.e., regional output is insufficient to satisfy regional demand, then related region will satisfy their demand by importing good and services from other regions in country or vice versa. In Commodity Balance approach, regions are either importing to satisfy their regional demand in the related sector or exporting to other regions their supply surplus. Specific sector in the region is either export oriented or import oriented sector in this context. Another problem with this principle is that it ignores the fact that any industry commodity in practice will be an aggregation of a number of quite distinct commodities (Flegg *et al.* 2014). So, this method or other LQ methods alone will underestimate the interregional trade flows.

Many Turkish cities relative size in terms of economy are relatively smaller according to cities like Istanbul, Ankara or Izmir. A small region might have few local suppliers of each commodity, whereas more goods and services options might exist in a larger region. The key relative size here is the range of product in bigger regions. Even if small regions produce same kind of good, product differentiation allows to see more cross hauling between regions. One example can be given about food processing industry. For instance, majority of milk products of PINAR are produced in Izmir and shipped from Izmir, where company's headquarters is located, to Marmara region, where another important brand in milk products SUTAS has their production fams and headquarters in Karacabey/Bursa.

For these reasons, one might expect to see more cross-hauling between regions. Since commodity balance approach does not take cross hauling into account, size of the rade between regions will be underestimated. To overcome this problem, Kronenberg (2009) develops a nonsurvey method so-called CHARM that does account for cross-hauling. Cross-Hauling Adjusted Regionalization Method (CHARM) is basically a variant of the commodity balance (CB) approach and it is firstly applied for two region model. It accounts for cross-hauling by estimating product heterogeneity and calculates the interregional trade between two regions. Kronenberg (2009) assumes that Tobben and Kronenberg (2015) extends the CHARM metod to the case bi and multi-regional IO tables.

The basic idea behind the CHARM approach is to calculate the shares of cross-hauling observed in national trade with the rest of the world and then apply these shares to regional data (Tobben and Kronenber, 2015). Mathematically, cross hauling is the difference between trade volume and trade balance, as seen in the following formula:

$$q_i = (e_i + m_i) - |e_i - m_i| \tag{13}$$

where $(e_i + m_i)$ is the volume (v_i) and $|e_i - m_i|$ is the balance of trade (b_i) , respectively. Since cross hauling is a function product heterogeneity, we need to calculate the degree of product heterogeneity, h_i. For purposes of cross hauling estimation, q_i is proportional to the sum of domestic production, x_i^n, intermediate use, z_i^n, and domestic final use, fd_i^n, with the factor of heterogeneity of commodities, h_i, as represented in the following equation:

$$q_i^n = h_i^n (x_i^n + z_i^n + fd_i^n) \tag{14}$$

and it can be arranged like below:

$$h_i^n = \frac{q_i^n}{(x_i^n + z_i^n + fd_i^n)} = \frac{v_i^n - |b_i^n|}{(x_i^n + z_i^n + fd_i^n)} \tag{15}$$

The most important point in CHARM method (Kronenberg, 2009) is that regional and national cross-hauling shares are assumed to be equal for each commodity, $h_i^n = h_i^r$. The idea behind this argument suggests that national level product heterogeneity which is calculated from national export and import data and national level intermediate and final demand data, mirrors the regional level product heteregoneity also. Since this argument looks a bit problematic, it is basically based on the argument that product heterogeneity is a characteristic of commodities rather than of a specific region. So according to Kronenberg (2009), large share of cross-hauled commodities observed in national data indicates that the respective commodities are characterized by a high degree of heterogeneity.

On the other hand, product heterogeneity is the key part of cross hauling estimations and we believe that heterogeneity index calculated from national data may cause higher or lower trade flows in interregional trade of some specific sectors. On the contrary of the assumption about national product heterogeneity is equal to regional product herteroeity in Kronenberg (2009), we modified the original CHARM method and calculated the product heterogeneity on the basis of regional data. The regional and national level product heterogeities in Turkey can be seen at Table 7.

Table 7. Product Heterogeneity by Regions

	Turkey	Istanbul	Marmara	Izmir	Aegean	Ankara	Central Anatolia	Mediterranean	South East	East Anatolia	West Black Sea	East Black Sea
Agr.	0.06691	0.13606	0.01141	0.05837	0.00945	0.01799	0.00965	0.04335	0.04102	0.00642	0.01352	0.00519
Food	0.05175	0.21415	0.03434	0.03285	0.02124	0.04910	0.00967	0.02051	0.02994	0.00149	0.00801	0.00097
Textile	0.11961	0.28886	0.08817	0.12134	0.07011	0.07463	0.06999	0.06996	0.05367	0.00858	0.02552	0.01014
Cons.	0	0	0	0	0	0	0	0	0	0	0	0
Trans.	0.05450	0.14611	0.05983	0.05328	0.03737	0.05746	0.02229	0.03470	0.03377	0.00341	0.02844	0.00442
Mach.	0.49117	0.56449	0.18610	0.27939	0.20754	0.36255	0.12216	0.11568	0.13617	0.04978	0.12337	0.07273
Oth.ind.	0.21688	0.41709	0.17219	0.20764	0.10705	0.19115	0.07715	0.12275	0.21570	0.02877	0.04551	0.07160
Serv.	0.01447	0.02226	0.00824	0.02103	0.00308	0.00126	0.00068	0.01188	0.00147	0.00084	0.00751	0.00016

Table 7 displays the values of h_i^nobtained using Turkish national data and h_i^r for each region using regional foreign trade, intermediate and final demand data like in equation (13). As can be seen, regional data can cause to vary product heterogeneity from region to region. Since this is the key variable to calculate cross hauling volume between regions, national level datas can overestimate the flows for especialy small economies like East Black Sea region or East Anatolia region.

By following CHARM method (Tobben and Kronenberg, 2015), regional domestic export to rest of Turkey and import from rest of Turkey values can be calculated from regional cross-hauling and commodity balance of regions. From cross-hauling eq. (13), gross exports and imports are calculated as the following way in Kronenberg (2009):

$$e_i = {(v_i + b_i)}/{2} \qquad m_i = {(v_i - b_i)}/{2} \tag{16}$$

From eq. (3), export or import can be written in terms of q_i, cross hauling, and it also equals trade valume and trade balance like above. Hovewer, Tobben and Kronenberg (2015) use regional commodity balance equation (Equation 2) in calculation in the interregional trade flows. By subtracting foreign imports and exports from regional commodity balance system, the remaining potential for cross-hauling in interregional trade for each region is taken into account in this fashion. We also use regional commodity balance rather than trade balance in the original CHARM method. Regional export to rest of Turkey and import from rest of Turkey for each region can be calculated like in the following ways:

$$e_i^r = \frac{q_i^r + |cb_i^r| + cb_i^r}{2} \tag{17}$$

$$m_i^r = \frac{q_i^r + |cb_i^r| - cb_i^r}{2} \tag{18}$$

Here, import and export are written as functions of trade volumes and trade balances for each commodity in each region. We need to emphasize once more that trade volume is equal to the sum of cross hauling and trade balance for each commodity in each region from equation (12).

All of these efforts can deliver estimates of interregional trade flows between region and the rest of the region as a whole. Namely, these export and import estimates do not constitute an origin destination matrix of interregional trade. It only delivers row and column sum of this matrix. So, the second step is to allocate these row and colum sums to bilateral basis. Namely, we need to define the flows between Istanbul and Marmara, Ankara, Izmir etc. instead of the rest of Turkey. We know that sum of the regional imports from the rest of the country for each product equals the regional export to exports to rest of the country for each product. Our findings are very close to interregional trade data of Ministry of Science, Industry and Technology as cen be seen at Table 8. One needs to note that, survey data also includes the transportation and trade margins and related taxes. However, our estimations do not take care these margins into account for the sake of price consistency in MRSAM.[1]

Table 8. Regional Domestic Trade (in Million TL)

	Export to ROT		Import from ROT	
	Survey Data	Estimation Results	Survey Data	Estimation Results
Istanbul	475.2	421.2	424.4	386.6
Marmara	220.7	164.1	179.1	103.2
Izmir	99.8	51.6	82.1	31.2
Aegean	51.4	39.2	68.1	52.1
Ankara	177.3	65.5	168.5	62.1
Central Anatolia	53.5	37.9	73.9	54.6
Mediterranean	90.6	39.4	114.1	59.9
Soth East	51.8	35.6	74	68
East Anatolia	13.7	22.7	32.4	44.71
West Black Sea	38.3	26.8	45.7	33.19
East Black Sea	14.2	19.5	24.3	29.2

From related region to rest of Turkey, trade will constitute row and column sum of interregional trade matrix in origin-destination basis. To further disaggregation of these row and column sum of interregional trade matrix, we will fallow a simple approach here, instead of some gravity models or some mechanical and mathematical methods such as RAS. By following Tobben and Kronenberg (2015), the approach for generating initial values that we adopted is to allocate imports or exports from the rest of the country to the regions of origin according to their market share in total interregional imports or exports (except exports of the importing region or vice versa). Aggregated version of interregional trade flows (which is not including sectoral decomposition of trade) can be seen at Table A2. Interregional trade flows between regions can be estimated as:

$$t_i^{rs} = \frac{t_i^{roc\,s}}{\sum t_i - t_i^{s\,roc}} \quad (18)$$

Where t_i^{rs} denotes the export from region r to region s in sector i, $\sum t_i$ denotes the export of all other regions in sector i (except region r) to rest of Turkey. With this fashion, interregional exports can be seen as a contribution of the regions to a pool of commodities available for interregional purchases. The export or import shares of the region in this pool will be used to allocate total interregional imports or exports of a specific region to their region of origin. As we already mention, unfortunately, this dataset does not include the sectoral breakdowns of interregional trade.

Consequently, our efforts in order to build the first Turkish multi-regional SAM finish and the remaining task is to control the row and column sums of the MRSAM. If one finds any inequality especially at the last region, namely bottom rightest region in MRSAM matrix, this can be solved by using again cross entropy method.

4. Conculusion

Regional analysis is very important to see regional impacts of national policies or vice versa the impacts of regional policies to neigboring regions. Multi regional CGE models are very capable to see these kind of policy assessments. Hovewer, data needs of these models hinder the ability of application of spatial CGE models. Potential accuracy and also feasibility of any applied CGE

[1] if one uses survey data to disaggregate sectoral breakdowns, then further correction is needed to avoid double counting of taxes and margins.

model significantly depends on the availability and reliability of data. This study is assumed to provide confident donations to applied multi regional or also known spatial CGE modeling, by maintaining an up to date database and non survey method to regionalize the national SAM. To the greatest extent possible, we relied on national and regional datasets and non survey methods which is fitting to case of Turkey.

Current study generates three fundamental contributions to regional economic analysis; i) a Multi-Regional SAM consisting of very detailed and flexible structure of regional and national accounts that can fit to various regional policy questions of modelers and related institutions is produced. Here in this study, we also showed a proper definition of government block of national SAM by following Telli *et al.* (2007), ii) a convenient method to regionalize the national SAM has been adopted and one can also follow the same procedure to construct his or her own MRSAM according to his or her needs; iii) interregional trade flows, which is very scarce data for many countries, has been both generated in this study mostly by following CHARM method (Tobben and Kronenberg, 2015) and also its demonstration in the MRSAM has brought easiness in MRSAM frameworks.

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Appendix

Table A1. Regional Decomposition Table

Regions in TurkMRSAM	Subregions (NUTS 2)	Cities (Nuts 3)
Istanbul	Istanbul Subregion	Istanbul Province
Marmara Region	Tekirdag Subregion Balıkesir Subregion Bursa Subregion Kocaeli Subregion	Tekirdag, Edirne, Kirklareli Balikesir, Canakkale Bursa, Eskisehir, Bilecik Kocaeli, Sakarya, Duzce, Bolu, Yalova
Izmir	Izmir Subregion	Izmir Province
Aegean Region	Aydın Subregion Manisa Subregion	Aydin, Denizli, Mugla Manisa, Afyon, Kutahya, Usak
Ankara	Ankara Subregion	Ankara Province
Central Anatolia Region	Konya Subregion Kirikkale Subregion Kayseri Subregion	Konya, Karaman Kirikkale, Aksaray, Nigde, Nevsehir, Kirsehir Kayseri, Sivas, Yozgat
Mediterranean Region	Antalya Subregion Adana Subregion Hatay Subregion	Antalya, Isparta, Burdur Adana, Mersin Hatay, Kahramanmaras, Osmaniye
West Black Sea Region	Zonguldak Subregion Kastamonu Subregion Samsun Subregion	Zonguldak, Karabuk, Bartin Kastamonu, Cankiri, Sinop Samsun, Tokat, Corum, Amasya
East Balck Sea Region	Trabzon Subregion	Trabzon, Ordu, Giresun, Rize, Artvin, Gumushane
East Anatolia Region	Erzurum Subregion Agri Subregion Malatya Subregion Van Subregion	Erzurum, Erzincan, Bayburt Agri, Kars, Igdir, Ardahan Malatya, Elazig, Bingol, Tunceli Van, Mus, Bitlis, Hakkari
Southeast Anatolia	Gaziantep Subregion Sanliurfa Subregion Mardin Subregion	Gaziantep, Adiyaman, Kilis Sanliurfa, Diyarbakir Batman, Sirnak, Siirt

Table A2. Interregional Trade Flows (in millions TL)

	Istanbul	Marmara	Izmir	Aegean	Ankara	Central Anatolia	Mediterranean	South East	East Anatolia	West Black Sea	East Black Sea	Export to Rest of Turkey
Istanbul	0	86.9	21.9	42.7	41	47.3	43.9	48.9	38.3	27.4	22.9	421.2
Marmara	131.8	0	2.3	3.5	6	2.2	7.7	4.9	2.5	1.9	1.3	164.1
Izmir	38.6	4.2	0	1.2	1.3	1.1	1.6	1.3	0.9	0.9	0.5	51.6
Aegean	28.7	1.7	1.5	0	3.2	0.3	1.4	1.1	0.3	0.2	0.8	39.2
Ankara	45.4	6.2	0.6	2.4	0	2.7	1.4	1.9	1.8	2.1	1	65.5
Central Anatolia	28.8	1	1.3	0.3	3.1	0	1.3	1.1	0.2	0.1	0.7	37.9
Mediterranean	23.9	1.4	1.3	0.5	2.3	0.5	0	7.7	0.4	0.4	1	39.4
South East	30.2	0.7	0.9	0.2	1.8	0.2	0.8	0	0.2	0.1	0.5	35.6
East Anatolia	19.9	0.1	0.6	0.06	1.1	0.05	0.5	0.2	0	0.02	0.2	22.7
West Black Sea	22.1	0.7	0.7	0.3	1.3	0.2	0.7	0.4	0.09	0	0.3	26.8
East Black Sea	17.2	0.3	0.1	0.07	0.6	0.05	0.6	0.5	0.02	0.07	0	19.5
Import from Rest of Turkey	386.6	103.2	31.2	52.1	62.1	54.6	59.9	68	44.71	33.19	29.2	