An Application of the Hybrid Approach to Constructing Regional Input-Output Tables: Case of Izmir, Turkey

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Abstract

The hybrid approach to constructing regional I-O tables is cost efficient and relatively reliable. Even though road maps as to how to prepare regional tables are available, it is important to share experiences to reveal practical pitfalls. Also, it is necessary to assess whether additional information provided by regional I-O tables is worth the effort. This study details the preparation of the 2008 IZKA İzmir Table, a regional I-O table constructed for İzmir region. The important sectors implied by the regional I-O table are compared to IZKA's (İzmir Regional Development Agency) previous analysis of the region to reveal the contributions of the regional table to the understanding of the sector.

Keywords

Input-output models; regional planning; applied regional analysis; hybrid regional tables

JEL Codes

C67, C81, O21, R11, R15, R58

Introduction

Based on Leontieff's Nobel-winning contributions, I-O (input-output) tables provide a detailed snapshot of an economy. Through an I-O table, it is possible to examine the intermediate input trade between sectors, observe the components of final demand by sectors and isolate components of created value added and the production process. I-O tables provide information on not only the absolute magnitudes of intersectoral exchange, but also dependencies across sectors. Interactions of sectors with various agents of the economy can also be observed, for underlying the concept of an IO table is a circular flow of the economy.

I-O tables are generally generated by national statistics institutions and are aimed to provide a nationwide level analysis of the economy. Academic scrutiny has also yielded tables constructed to address specific research questions. Minx, Wiedmann, Wood, Peters, Lenzen, Owen, Scott, Barret, Hubacek, Baiocchi, Paul, Dawkins, Briggs, Guan, Suh and Ackerman (2009) quantifies the carbon emission effects of production on the environment. Lin and Polenske (1995) examine sectorial energy usage. Luo (2013) attempts to identify the sectors which should be supported in times of crisis. Leung and Secrieru (2012) analyses the interaction between real and financial sectors of the economy.

Even though I-O tables are generally denoted in money units, tables denoted in quantities are also prepared. Labeled as *monetary* and *physical* tables, they can be used to examine physical aspects of economic activity. For example, Dietzenbacher (2005) analyses waste management through a physical I-O table. However, these tables need to be approached with caution, especially about the current and constant prices that have been used (Dietzenbacher and Temurshoev, 2012).

With their potential for policy contribution recognized but yet not fulfilled, regional I-O tables are yet to make a grand entry to the realm of economic policy analysis. The obstacles seem to be twofold. Firstly, modelers suffer from a lack of detailed regional data (Hewings and Jensen, 1988; Canning and Wang, 2004). Secondly, authors' experiences in the field have shown that regional table construction is perceived to be a highly technical task. Lacking technical capacity, regional actors refrain from investing in this tool of high policy analysis value.

These concerns are true to a certain point. If a regional I-O table is desired, there are basically three approaches that can be adopted (Greenstreet, 1989; Statistics New Zealand, 2003; Bonfiglio, 2005; Miller and Blair, 2009). The first approach is *the survey method*. Given lack of adequate regional data, the survey method emphasizes collection of data through surveys. Addressed to the firms of the region, conducted surveys may be *full* *surveys*. Full surveys aim to obtain all possible information about sales and purchases of the firms. However, full surveys are prohibitively costly and the alternatives of *rows-only* or *column-only* survey methods may be adopted. Rows-only surveys aim to gather information on sales whereas columns-only surveys question the details of purchases. But, time and money costs remain considerably high for rows-only and column-only alternatives as well.

Second approach is the non-survey method. This method relies on a national I-O table and employs assumptions to create a regional table from the national table. The non-survey method has a considerable cost advantage over the survey method; Boster and Martin (1972) claim that the ratio of the cost of a survey table to the cost of a non-survey table may be as high as 20 to 1. The problem with this approach relates to the reliability of the adopted assumptions. National I-O table is a reflection of a linear production technology with coefficients relating intermediate inputs used by a sector to that sector's total output. Would these coefficients continue to hold at the regional level, or should they be modified to reflect the region's technological differences from the nation? If the answer is yes, which strategy should be adopted to change the national coefficients? Are the obtained results really representative of the regional economy or are they a reflection of the researcher's biases? These concerns exemplify the weakness of a purely non-survey approach: the underlying assumptions and adopted technical framework may be inconsistent with the facts of the region.

The third approach is the hybrid method. The hybrid method combines the advantages of the survey and non-survey methods while eliminating the weaknesses of the two approaches. Like the non-survey method, the hybrid method starts with the construction of a draft regional I-O table from a national table. Then, the assumptions that have been employed are checked through the employment of superior data, where superior data is information on the region from data-providing institutions, limited surveys or interviews with experts.

As a feasible alternative, the hybrid approach avoids the high cost of the survey method (Lahr, 2001; Fritz et. al. 2002) and enables checking the obtained regional I-O table through alternative sources. Corrections on the constructed table are possible and thus a relatively reliable regional I-O table can be obtained. Relative ease of implementation, low cost, and support from superior data make the hybrid method a preferred approach for the construction of regional I-O tables (See, for example, Kronenberg and Többen (2011) for an implementation in Germany).

Especially in developing countries, regional actors, even national institutions, sometimes lack resources to construct detailed regional I-O tables. However, input from regional I-O tables to the policy formulation process can be crucial. Thus it is important to construct regional tables and the hybrid method is a viable alternative. However, implementation details may vary across regions and thus it is important to share the experience of regional I-O table construction. In other words, the method needs to be exemplified and experiences need to be shared.

This need for shared experiences is the inspiration for this paper. This paper aims to provide an example for the regional I-O table construction process and comment on whether the regional table has provided a new perspective on the region. Specifically, the regional I-O table of Izmir, Turkey, is considered. The paper presents the experience of the regional I-O table construction process. Then the obtained results are summarized. Finally, obtained results are evaluated as compared to an already existing analysis of the region.

The regional I-O table of Izmir has been constructed to be employed by IZKA, Izmir Regional Development Agency, to conduct policy analysis and identify key sectors of the region. IZKA already has an analysis of the region; therefore, it is possible to determine whether the regional I-O table provides new clues as to the economic structure of the Izmir region. Therefore, the contributions of this paper are i) implementation of the hybrid method is exemplified, ii) regional I-O table for Izmir, Turkey, is presented, iii) the regional I-O table is evaluated in terms of its contribution to an existing perspective of the region.

The study progresses as follows: Next section presents a regional I-O model. The following section presents an algorithm for regional I-O table construction and summarizes experience for Izmir, Turkey. Last section summarizes the results of the constructed table and compares it to the previous observations of IZKA on Izmir. Final section concludes.

A regional I-O model

Within this study, a standard static, open Leontief model is considered. The model is static in the sense that there is no time dimension. It is open, for both final demands and basic inputs are exogenous.

For a typical sector *i*, the equilibrium condition is written as the equality of supply and demand in the considered region for each sector. Supply of sector outputs is due to regional production and purchases from the rest of the world (i.e. other countries) and other regions in the country. Demand has an intermediate and a final component. Intermediate demand is the demands by any sector j to the output of sector *i* for production purposes. That is, in order to produce, sector *j* requires the output of sector *i* as an input. Final demand items include consumption demand, investment demand, government demand, demand from other regions of the economy and the demand from the rest of the world. Specifically, for the typical i^{th} sector;

$$X_i + M_i^{TR} + M_i^{D} = \sum_j^N X_{ij} + C_i + Z_i + G_i + E_i^{TR} + E_i^{D} \quad (\text{for } i = 1, 2, ..., N) \qquad (1)$$

where,

X_i : output of sector *i*

M_i^{TR} : purchases of sector *i* from the rest of Turkey

M_i^{D} : imports of sector *i*

X_{ij} : intermediate sales of sector *i* to sector *j*

C_i : consumption demand for output of sector *i*

Z_i : investment demand for output of sector *i*

G_i : government demand for output of sector *i*

E_i^{TR} : sales of sector *i* to the rest of Turkey

E_i^{D} : exports of sector *i*

Rearrangement yields

$$X_i = \sum_j X_{ij} + C_i + Z_i + G_i + E_i^D - M_i^D + NE_i^{TR} \qquad (\text{for } i = 1, ..., N) \qquad (2)$$

where, $NE_i^{TR} = E_i^{TR} - M_i^{TR}$, is net sales to the rest of Turkey

With the assumption of linearity in intermediate input usage, $X_{ij} = a_{ij}X_j$ where a_{ij} represents the *technical coefficients*. This equation can be written as:

$$X_i = \sum_j a_{ij}X_{ij} + C_{i0} + Z_{i0} + G_{i0} + E_{i0}^D - M_{i0}^D + NE_{i0}^{TR} \qquad (\text{for } i = 1, ..., N) \qquad (3)$$

where the subindex *0* represents an exogenous variable. This system of equations can be summarized by matrix notation:

$$\mathbf{X} = \mathbf{AX} + \mathbf{C}_0 + \mathbf{Z}_0 + \mathbf{G}_0 + \mathbf{E}_0^D - \mathbf{M}_0^D + \mathbf{NE}_0^{TR} \qquad (4)$$

The solution is obtained as:

$$\mathbf{X}^* = (\mathbf{I} - \mathbf{A})^{-1} (\mathbf{C}_0 + \mathbf{Z}_0 + \mathbf{G}_0 + \mathbf{E}^D – \mathbf{M}_0^D + \mathbf{NE}_0^{TR}) \qquad (5)$$

where $(\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief inverse.

The theoretical construction has two implications. Firstly, Equation five can be used to analyze the effects of any exogenous shocks on the considered region; Izmir in this case. Secondly, given total supply and total demand, net sales of Izmir to the rest of Turkey can be calculated as a residual.

Table 1 – Components of a Regional I-O Table

	Intermediate Uses: Sectors (j)	Intermediate Uses: **Sum**	Regional Final Uses	Net Sales to the Rest of Turkey	Exports	Imports
Sectors (i)	**SECTION II** X_{ij}	. . $\sum_i X_{ij}$ . .	**SECTION I** C_i, Z_i, G_i	$E_i^{TR} - M_i^{TR}$	E_i^{D}	M_i^{D}
Sum	. . . $\sum_j X_{ij}$ . . .					
Basic Inputs and Taxes on Production	**SECTION III**					
Regional Output	. . . X_j . . .					

However, any analysis to be conducted requires a data gathering process that leads to a regional I-O table for İzmir. Following Aydoğuş (2010: 21), basic components of a regional I-O table are presented in Table 1. Following columns, one can track the items that contribute to the regional supply. Section II records intermediate uses; i.e. how much a given sector j uses intermediate inputs from all other sectors, indexed *i*. This is followed by usage of basic inputs, like capital and labor, and tax payments; all recorded in Section III for each sector j. Intermediate inputs and basic inputs are used to create regional output of each sector, X_j. Adding imports to regional output yields regional supply for each sector.

Tracking rows, one can determine how the output of each sector is used. Firstly, the output of any sector i is demanded as intermediate input. Additionally, there is the final demand. Output of any sector i is demanded for consumption purposes (C_i), for investment purposes (Z_i), by government for public consumption (G_i) and by other countries as exports (E_i^D). Sum of final and intermediate demand is regional demand. Finally, Equation four implies that any difference between regional demand and regional supply is net export of the region to the rest of the country.

Table construction

As stated, it is important to share the experience of regional I-O table construction. Therefore, the experience of constructing the Izmir regional I-O table will now be summarized. First, an algorithm that outlines the table construction process is presented. Then, application of the process for the Izmir region is explained.

Regional I-O table construction algorithm

An algorithm for the hybrid method of constructing a regional I-O table can be divided into three main steps. These steps are summarized as follows:

Step 1: Update National I-O Table. The hybrid method of constructing a regional I-O table starts with a national table. The national table and the linear intermediate input usage technology it represents are modified to create a regional table. It is possible that the national table is not up-to-date, thus may require an update to a more recent year. Also, since the construction of a new table is due to the lack of intersectoral intermediate input flows, the elements of Section II on Table 1 need to be updated as well. This requires total intermediate uses and intermediate supplies; i.e. row and column sums of Section II.

Choose a target year. The choice of the year to which the national table will be updated depends on two criteria. First, and obvious, criterion is the availability of data. A second criterion is sectorial detail. A recent source of data may lack adequate sector detail. A data with adequate sector detail may be regarded as old data. Unfortunately a subjective selection between these two criteria is very difficult and it is up to the researcher's aims to determine the relative weights of these criteria.

Calculate aggregate intermediate uses. Given the choice of target year and identified data sources, second task is to calculate aggregate intermediate supplies and demands. Data on intermediate flows does not exist; therefore, algebra presented in the previous section and by Table 1 becomes crucial.

Details would vary due to available data and adopted algebraic structure; therefore, the application to the Izmir case becomes a crucial example.

Update intermediate input usage. The algorithm up to this point provides intermediate usage and supplies; that is, the row and column sums of Section II are available. However, elements of the interior of Section II need to be calculated for the target year, given the Section II of an available national I-O table. To clarify, assume that the latest available national I-O table is for year 2002 and the table is to be updated to year 2008. All data of Section II for year 2002 are available but only row and column sums of Section II are available for year 2008. The problem is to fill the elements of Section II for year 2008. This is a matrix balancing exercise and a most common approach is to use the RAS algorithm, though different methods based on the same approach exist (Jackson and Murray, 2004).

Step 2: Localizing National I-O Table. Given the up-to-date national I-O table, it is now possible to get a draft regional I-O table. Before proceeding, remember that linearity in intermediate input usage, $X_{ij} = a_{ij}X_j$ has been assumed. To take the next step, further assume that if a sector is heavily concentrated in a region, the region is a good representation of the national technology and linear intermediate usage input usage still holds (Miller and Blair, 2009: 347-360). That is, if a sector is concentrated in a region, the coefficients a_{ij} continue to hold for that sector in that region. The tool to determine whether a sector is concentrated in a region is based on LQ (location quotient)

[1]. If LQ>1 for a sector, the sector is concentrated in the region and the national technical coefficient a_{ij} still holds. Otherwise, the technical coefficient is multiplied by the value of LQ. This step enables generation of a draft regional I-O table.

Step 3: Verifying Draft Regional I-O Table. At this point, a draft regional I-O table is ready. It makes use of all available data on the region. However, the regional table is also the result of algebraic procedures and requires validation. The verification of the draft table is, in essence, acquisition of superior information on technical coefficients, a_{ij}, from relevant individuals or institutions. These could include, but are not limited to, professional organizations such as commerce and industry chambers, experts of public institutions, leading companies of the region etc. Such work can be done either through questionnaires or interviews. However, questionnaires would be inappropriate for two reasons. First, since

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[1] For any variable X, the LQ is calculated as (X_{ir}/X_r) / (X_{ic}/X_c) where X_{ic} is the value of X for sector i in region r, X_r is total value for region r. X_{ic} is the value of X for sector i in region c, X_c is total value for the whole country. If LQ>1, concentration of sector i in region r is greater than the national average. See Morrison and Smith (1974), Eskelinen and Suorsa (1980), and, Sawyer and Miller (1983) for application of LQ coefficients for regional I-O table construction.

the questions would be related to technical coefficients, the interviewees need to be provided with detailed instructions and technical information; a simpler workaround is to visit the interviewee in person. Secondly, the sectorial detail of an I-O table is too broad and an interviewee needs to be informed on the coverage of sectors to improve feedback accuracy. This requires providing many pages of sectorial detail lists; once again, an interview is more efficient in terms of response accuracy.

Application: 2008 IZKA Izmir table

The algorithm outlined above is broad enough to be applied to many cases. Similar algorithms are available (Miller and Blair, 2009: 69-118), however details of the implementation are hardly ever shared. Those details, however, prove to be most crucial in replicating the algorithm. Thus there is a need to share experiences; hence, this article. The experience of creating a regional I-O table for the Izmir region, Turkey, has provided the following highlights.

Step 1: Updating national I-O table

Choose a target year. Turkey's most recent national I-O table is for the year 2002, includes 59 sectors and is based on the NACE Rev 1.1 classification. Before updating the national table, a target year has to be identified. That is, the year to which the national table will be updated must be determined. The choices are limited by the availability of detailed sectorial data. Though lacking details in some sectors, the most comprehensive and publicly available source of data is Annual Industry and Service Statistics of TurkStat (TurkStat, 2013a). The AISS conducted for year 2008 is publicly available from TurkStat's webpage and is based on NACE Rev 1.1 classification. Due to the relatively rich data detail and classification consistency potential presented by this survey, year 2008 is chosen as the target year and the 2002 Turkey I-O Table is updated to year 2008.

The AISS database and the 2002 Turkey I-O Table (TurkStat, 2013b) have been further supplemented by the following data sources:

- TurkStat's GDP by production approach (includes value added and tax net of subsidies data on 17 branches of economic activity)
- TurkStat's GDP by expenditure approach (includes details on components of final demand)
- TurkStat's GDP by income approach (includes data on compensation of employees)
- TurkStat's 2008 Household Budget Survey Database (includes data on sectorial division of final consumption expenditures by households)
- Budget Statistics, Ministry of Finance (includes data on gathered taxes and government expenditures)

- TurkStat’s Foreign Trade Database (includes sectorial trade data, excluding certain service sectors)
- Central Bank of Republic of Turkey, Balance of Payments, Service Trade Statistics (includes data on international trade in services),
- Social Security Institution Formal Employment data on sectorial formal employment

Calculate aggregate intermediate uses: Due to limits on data availability, the 59 sectors of the 2002 Turkey I-O Table have been aggregated to 36 sectors. For these 36 sectors, the update process aims to gather data on final uses (Section II of Table 1) and basic inputs (Section III of Table 1) for year 2008. Then, elements of Section II can be obtained through a matrix balancing algorithm, like RAS.

Section I includes sectorial detail on final consumption expenditure by households, final consumption expenditure by government, capital formation and exports. These items, in aggregate, can be obtained from national accounts. Sectorial distribution of final consumption expenditure by households is based on TurkStat’s Household Budget Surveys. Distribution of 2008 government consumption is based on the sectorial distribution in 2002. Capital formation uses are also distributed according to the 2002 Turkey I-O Table sectorial distribution. However, sectorial fine-tuning based on sectorial investment figures in Ministry of Development’s Economic and Social Indicators has been performed. The last item of final uses is exports; exports are treated together with imports. The basic foreign trade data source is TurkStat, but augmentation from Central Bank's Balance of Payment Statistics has been necessary in order to obtain trade in services.

The calculations for the basic inputs (Section III) start with the distribution of year 2008 value added to sectors. A limited sectorial distribution of value added is available from the national accounts. This available sectorial distribution is enhanced with relatively more sectorial detail from AISS. Sectorial production values have been updated with sectorial output growths implied by the AISS from 2004 to 2008; the 2002 to 2004 growth has been taken into account through inflation.

Net taxes on products have been obtained from TurkStat's national income accounts. Distribution of net taxes has been based on the 2002 Turkey I-O Table; with limited rearrangements due to tax data from Ministry of Finance.

Compensation of employees is based on the national accounts, with sectorial distribution based on both the national accounts and the data on labor costs in TurkStat's AISS. Given labor costs and value added, operating surplus is obtained by deducting compensation of employees from gross value added. Finally, sectorial supplies are calculated by summing production and imports. As this task is performed, it becomes important to maintain a clear definition of terms such as operating surplus and net taxes. In order to maintain definition consistency, the metadata of TurkStat's 2002 National I-O Table of Turkey has been adopted for definitions[2].

Update intermediate input usage: Once data on final uses and basic inputs (and therefore output) is gathered, sums of intermediate transactions for each sector can be gathered. Specifically, rewriting Equation (4) for a national economy so that net regional sales, NE, are excluded:

$$\mathbf{X} = \mathbf{AX} + \mathbf{C}_0 + \mathbf{Z}_0 + \mathbf{G}_0 + \mathbf{E}_0^D - \mathbf{M}_0^D \qquad (6)$$

Equation six implies that, once elements of final demands and output are obtained for each sector, sums of intermediate uses can be obtained by simple algebra. The data gathering effort so far has yielded output for each sector and expenditure on basic inputs, including tax. Deducting basic input usage and net taxes from output yields expenditure on intermediate inputs; that is, the column sums of Section II. Similarly, given final demand and total supply for each sector, row sums of Section II can be obtained as well; for what is not used to meet final demand is used to meet intermediate input demand.

[2] For the metadata on 2002 National I-O Table of Turkey, see http://goo.gl/jT4Yun

The method to update intermediate uses (elements of Section II) is based on the RAS algorithm. The RAS algorithm is essentially an iterative table balancing algorithm (Bacharach, 1965; Bachem and Korte, 1979). The method starts from a source table and reaches a destination table, given the sums of rows and columns of the destination table (Altan and Ediz, 2009). The approach is most appropriate for this step of the study. The 2002 Turkey I-O Table has the inter-industry flows of intermediate inputs as a table, with row and column sums. The update of the national table to year 2008 has also yielded row and column sums of Section II (intermediate uses region) for year 2008. Given Section II row and column sums for 2008 and 2002 sectorial intermediate input use distributions, RAS algorithm has been implemented through Octave. The algorithm has yielded intermediate input trade between the 36 sectors in Turkey for year 2008. Thus the update of the national table to year 2008 has been completed.

Step 2: Localizing national table

Given the calculated 2008 Turkey I-O Table, it is now possible to obtain Izmir region's I-O table, the *2008 IZKA Izmir Table*. Izmir's I-O table has been constructed in two stages. The first stage includes estimation of Izmir's technical (direct input) coefficients (a_{ij}) from the national table. Then the calculated coefficients are confirmed through interviews with sector representatives and experts. The second stage involves gathering data to fill Section I (final uses in Izmir) and Section III (basic inputs in Izmir).

The calculation of Izmir’s technical coefficients relies on a basic assumption: If a sector is concentrated in a region, then that sector’s technical coefficients are equal to the national technical coefficients. If a sector is not concentrated in a region, then that sector’s regional technical coefficient is equal to the national coefficient multiplied by the measure of regional concentration.

Previously employed for regional concentration of manufacturing industry sectors in Turkey (Kumral and Değer, 2004), the LQ (Location Quotient) is a commonly adopted measure of regional concentration. The LQ has been scrutinized repeatedly and has been deemed an appropriate tool to generate regional technical coefficients (Kronenberg, 2012; Flegg and Webber, 1997; Schaffer and Chu, 1969). Therefore, LQ has been adopted to measure regional concentration and LQ values for the 36 sectors have been calculated using formal employment data from the Social Security Institution.

Step 3: Verifying draft regional table

Once the technical coefficients have been obtained, opinions on the coefficients from representative sector members have been sought. By making appointments, executive officers of various companies, sector committees of various business associations and commerce chambers, university researchers and experts from public institutions have been interviewed. With the support of Izmir Regional Development Agency, a total of 29 meetings were held for 36 sectors.

During these meetings, the participants were informed of the conducted research, the structure of I-O tables was briefly presented and then the concept of technical coefficients was explained. Then the calculated technical coefficients were presented to the participants and their opinions were asked with regard to the intermediate input usage implied by the coefficients. Based on these meetings, a number of changes have been introduced to the technical coefficients. This concludes the first stage of the construction of 2008 IZKA Izmir I-O Table.

Remaining task is to fill Section I and Section III of the regional table. Regarding Section I, the final uses: Final consumption by households is based on the rate of per capita value added in Izmir to per capita value added in Turkey; the ratio is assumed to represent the ratio of per capita consumption as well. Thus given populations of Izmir and Turkey and the consumption for Turkey, Izmir's total final consumption expenditure is calculated. The sectorial distribution is based on Household Budget Surveys and the distribution in 2008 Turkey I-O Table.

The sum of government final consumption expenditure in Izmir is based on the ratio of government spending in Izmir to government spending in Turkey, calculated from Ministry of Finance statistics. Capital formation is based on Izmir's share of private investment incentives and public investment; data is based on public investment figures by Ministry of Development and investment subsidies from Ministry of Economy.

The calculations for Section III have started from output at basic prices. It is assumed that output for any sector in Izmir is a share of output of the same sector in Turkey, where shares are based on sales figures provided by Ministry of Finance. As for created value added; it is assumed that if a sector is concentrated in the region, as measured by the LQ indices, value added to output share in the region is the same as the share in Turkey. This enables calculation of value added for a number of sectors in Izmir. Also, the total value added in Izmir is calculated from national accounts to be about 7% of national value added; thus the total value added created in Izmir is obtained. The difference between Izmir's value added and the value added obtained for a subset of sectors is distributed to the un-concentrated sectors proportional to their sales in Izmir, where sales figures are obtained from Ministry of Finance.

The sum of net taxes on products in Izmir is calculated by the rate of indirect taxes collected in Izmir to the indirect taxes collected in Turkey; the rate is calculated from budget statistics of Ministry of Finance. Distribution of taxes to intermediate uses and final uses is done in accordance with the rates for the 2008 Turkey I-O Table. In order to distribute net taxes on intermediate uses to sectors, ratio of output in Izmir to output in Turkey has been used.

Next, value added has been divided to compensation of employees and operating surplus. National sectorial ratios of compensation of employees to value added have been used to obtain compensation of employees in the sectors in Izmir. Operating surplus is obtained as a residual from the value added.

Foreign trade is a difficult concept in regional I-O tables, especially for port regions like Izmir. Any recorded export from Izmir could be an export of Izmir itself, or the export of a firm located in another region in the hinterland of Izmir. Unfortunately, available data from TurkStat's Foreign Trade Statistics is based on customs declarations and it is not possible to isolate trade data as trade of Izmir and trade of other regions. However, for the provinces in the hinterland of Izmir have their own customs offices, it is assumed that the hinterland regions record their foreign trade in their own customs offices and foreign trade data for Izmir is not a serious overestimation.

TurkStat's Foreign Trade Statistics database lacks detailed data on some sectors; therefore, these sectors have required special attention. For "electricity, gas, steam and hot water supply sector", regional trade is calculated as a ratio of national trade, where the ratio is due to the number of establishments in Izmir divided by the number of establishments in Turkey. Same approach has been adopted for "construction", "retail and wholesale trade", "land, water and air transport and transport via pipelines and communications", and, "other services" sectors. "The hotels and restaurants" sector is assumed to reflect tourism. Therefore, calculations on international trade in hotel and restaurant services are based on the number of visitor arrivals and departures by residence. Data is available through TurkStat. Izmir's ratio to Turkey has been once more adopted to obtain Izmir's international trade in hotel and restaurant related services; this time the key variable is the number of visitor arrivals.

Given output values for all the 36 sectors and the technical coefficients, it is possible to obtain intermediate uses in Izmir. Section II of 2008 IZKA Izmir I-O Table can be filled by multiplying output values with technical coefficients. Thus the construction of the 2008 IZKA Izmir I-O Table has been completed.

Using The 2008 IZKA Izmir I-O Table

With the regional I-O table at hand, a logical question to ask is whether the table contributes to the understanding of the region. In order to answer this question, first an analysis of Izmir region through the 2008 IZKA Izmir I-O Table is performed. Then, the obtained results are compared to an already existing analysis of the region; specifically, the analysis previously done by IZKA, the Izmir Regional Development Agency, on Izmir region.

Identification of key sectors in Izmir

A regional I-O table can be used to identify highlights of the region. This section first presents the findings of the analysis on the region. Then, the findings are compared to an existing analysis of the region. To perform this task, regional multipliers have been calculated and presented in Appendix Table A1. The calculated multipliers relate to production, labor income, employment, tax and imports.

In terms of production, top places are taken by manufacturing sectors, with the exception of recycling. In order; "manufacture of motor vehicles, trailers and semi-trailers", "recycling", "manufacture of basic metals", "manufacture of furniture; other manufactured goods not elsewhere classified", and, "manufacture of fabricated metal products, except machinery and equipment" sectors have the highest production impacts. The list is not surprising, given the strong existence of metal processing industry in İzmir, with ship dismantling facilities that provide scrap metal through recycling to the metal processors.

Income multipliers show the increases in labor income. Highest increases are in "education services", "health and social work services", "financial Intermediation", "other services", and, "construction" services. The list shows the high income generation capability of the region through services sectors and highlights the role of Izmir as a major exporting port, with business related services concentrated in the region.

The increase in labor demand is observed through employment multipliers. In response to an increase in final demand to output, highest labor demand increases are observed in manufacturing sectors. Leading sectors in this regard are "manufacture of furniture; other manufactured goods not elsewhere classified", "manufacture of wearing apparel; dressing and dyeing of fur", "manufacture of medical, precision and optical instruments, watches and clocks", "manufacture of fabricated metal products, except machinery and equipment", "manufacture of wood and products of wood and cork (except furniture); articles of straw and plaiting materials".

Highest tax revenue creation is through “agriculture, hunting and forestry”, “manufacture of coke, refined petroleum products and nuclear fuels”, “mining and quarrying”, “tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear”, and, “transport, storage and communication” sectors.

Finally, the highest imports are created by “recycling”, “manufacture of basic metals”, “manufacture of office machinery and computers”, “manufacture of medical, precision and optical instruments, watches and clocks”, and, “manufacture of other transport equipment” sectors. The high import dependency of recycling and metal production are due to the ship dismantling activities that take place in İzmir, which primarily use imported old ships and in turn provide input to metal production.

The revealed importance of manufacturing sectors is not surprising, for economic planning in Turkey has traditionally focused on nationwide emphasis on manufacturing. A shift from centralized economic planning paradigm to a regional paradigm is relatively recent; the importance of services is yet to make a grand entry into policy making practices. Some services sectors appear to have potential in İzmir. In terms of generated labor income, services take the lead. “Transport, storage and communication” services sector has one of the highest tax revenue creation potentials. These points to a need for detailed analysis of service sectors, especially with regard to their income generation potential.

Comparison to a previous analysis of İzmir

In order to formulate the region's development plan for the 2010-2013 period, İzmir Regional Development Agency (İZKA) has conducted a research on the situation of İzmir in 2009 (İZKA, 2009). The research has led to the identification of a number of key sectors for emphasis in the region's development perspective.

The first group of sectors emphasized by İZKA (2009) is agriculture dependent sectors. This emphasis has two dimensions. On one dimension, the value added created by the agriculture sector needs to be increased (İZKA, 2010: 45) with an increased interaction between agriculture and manufacturing industry (İZKA, 2010: 46-47). On the other dimension, textile manufacturing is recognized with it's potential to create a high level of value added. Knowledge intensive textile production and fashion design are two key concepts (İZKA, 2010: 47-48).

Regarding more traditional manufacturing industries, a number of sectors that are considered to be of high technological content are identified as key sectors (İZKA, 2010: 39-40; İZKA, 2009: 100). These are computer and office machine manufacturing, manufacture of medical equipment, and, manufacture of chemicals. Information related industries are also mentioned in this context.

Being one of the largest port cities in Turkey, İzmir is also stated to have a great potential in terms of logistics. Construction of a new commercial port is on the region's development agenda. However, there appears to be a need for improving the city's connections to the hinterland in terms of logistic efficiency; for the hinterland of the İzmir consists of cities with high production ability. Therefore, logistics is identified as a key sector.

İzmir province is also a tourism center of considerable importance. Çeşme part of the province is a major attraction for summer residence owners and wind surfers. Kuşadası part is well-known for Ephesus, an antique city. İzmir itself attracts considerable cruiser ship tourism, with multiple ships visiting during the high season. However, it has been stated that İzmir's tourism potential is not being fully utilized; improvement in service quality (İZKA, 2009: 101) and increased diversification in tourism (İZKA, 2010: 42) are deemed necessary.

The region also has great potential for renewable energy production. Geothermal, wind and solar energy production alternatives have great potential for the region (İZKA, 2010: 40-42). In order to realize this potential, additional investment is necessary. The planning vision for the region also includes the establishment of skills necessary for producing the relevant technology locally.

To sum up, İzmir Regional Development Agency's analysis of İzmir region emphasizes agriculture based industries; computer and office machine manufacturing; manufacture of medical equipment; manufacture of chemicals; information related activities; logistics; tourism; and renewable energy production.

The question is, are these sectors also revealed through a regional I-O analysis? Regarding agriculture based industries: "manufacture of wearing apparel; dressing and dyeing of fur" is important in terms of labor demand created by final demand shocks. Also, "tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear" has considerable tax revenue creation potential.

Regarding manufacture of medical equipment: region's analysis yields "manufacture of medical, precision and optical instruments, watches and clocks" as an important sector in terms of labor demand creation. However, an increased activity in this sector also triggers imports. Due to the existence of a refinery, İzmir region creates considerable tax revenue through "manufacture of coke, refined petroleum products and nuclear fuels". Being a port city, İzmir generate tax revenue through "transport, storage and communication", a representation of logistics sector considered important by IZKA.

I-O analysis of İzmir does not point to tourism and renewable energy production as important sectors in the region. However, anecdotal evidence would point that the region has considerable potential in these sectors. During interviews conducted for the construction of the regional I-O table, tourism sector representatives have stated that İzmir is unable fulfill its potential. İzmir attracts only 1/10th of the tourists attracted by Antalya, a tourism city in the south of Turkey. Regarding renewable energy production, increasing number of wind turbines around İzmir implies the sector has a future to be realized.

Finally, there is no computer production in İzmir, but “manufacture of office machinery and computers” sector has a large import effect. This implies that the sector exists, is underdeveloped and is considerably import dependent. A policy focus on the sector may prove fruitful in the medium to long run.

Conclusion

A crucial task for an in-depth analysis of an economy is to examine the interactions between sectors. The basic tool for this task is the I-O table. A table constructed for a region of an economy enables a detailed examination of the region’s economy. However, due to high cost and reliability problem, this task is not undertaken frequently.

This study outlines the preparation of a regional I-O table through the example of 2008 IZKA Izmir I-O Table, a 36 sector I-O table for the Izmir region of the Turkish economy. In order to prepare 2008 IZKA Izmir I-O Table, first the national I-O table of Turkey has been updated to year 2008. Following the update of the national table, the hybrid approach to the construction of a regional table has been adopted.

The table construction process is based on a regional model. The data is obtained from various institutions. Adopted assumptions and obtained regional technical coefficients have been verified through interviews with sector representatives, members of professional organizations and experts from various institutions.

The table construction experience highlights a number of points. Firstly, it is possible to construct regional I-O tables despite data limitations and without adopting complex numerical methods. Also, it is necessary to check the constructed table by consulting the relevant experts. For both data gathering and arranging meetings with various experts, institutional support is crucial. For this study, such support has been provided by IZKA, Izmir Regional Development Agency.

The results obtained from the regional I-O table are compared to the analysis of the region by IZKA. There is a considerable overlap between the results from the regional table and

IZKA's field research. Some sectors identified by IZKA for future development are not revealed by the I-O table, simply because they are underdeveloped and need support for development.

What, then, does a regional table contribute? Through the regional table it is possible to observe *why* a sector is important. For example, services sectors in İzmir have considerable labor income generation. Even though services are regarded important in İzmir, exact reason is hardly provided. The table is capable of answering such explanations.

Conducted analysis reveals that the production of basic inputs like metal, petroleum related inputs and chemicals are important in Izmir. Also, business supports services like logistics and trade are observed to be important as well. An examination of absolute magnitudes reveals that Izmir region's economy focuses on the production of unprocessed or relatively less processed inputs and related service sectors rather than the production of processed goods.

This conclusion points to the importance of services sectors for Izmir and highlights the need for detailed analysis of these sectors. This implies a major break from the traditional economic planning perspective of Turkey. The emphasis has always been on manufacturing sectors or trade, services have not been a major concern. This is reflected in the data gathering traditions of Turkish institutions as well; detailed data on services sectors is quite limited. However, for Izmir, services are revealed to be of considerable importance. The regional planning vision for Izmir needs to take services sector into consideration and take appropriate steps for data gathering. Unless this is done, it is difficult to clearly identify service sectors that need to be supported for regional development aims.

Another crucial observation is that Izmir provides easy access to *basic inputs* and *business support services*. Therefore Izmir economy can be restructured as an attraction for investment and may be turned into a brand as an investment region. This can be put forward as one of the policy paths that can be taken by the region's development agency, IZKA.

In conclusion; it is possible to construct regional I-O tables at low cost, as long as there is considerable regional institutional support. Such tables have policy contribution. They systematically quantify the importance of sectors identified for regional development support.

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Appendix: Tables

Table A1: Izmir Region Multipliers

		Multipliers				
		Production	Income	Employment*	Tax	Import
1	Agriculture, Hunting and Forestery	1.53	0.13	21	0.21	0.21
2	Fishing	1.79	0.17	21	0.08	0.18
3	Mining and Quarrying	1.67	0.21	10	0.18	0.23
4	Manufacture of food products and beverages	2.15	0.20	21	0.15	0.27
5	Manufacture of tobacco products	2.12	0.28	11	0.09	0.23
6	Manufacture of textiles and textile products	1.98	0.24	22	0.15	0.46
7	Manufacture of wearing apparel; dressing and dyeing of fur	2.22	0.28	34	0.12	0.28
8	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	2.41	0.24	28	0.16	0.71
9	Manufacture of Wood and products of wood and cork (except furniture); articles of straw and plaiting materials	2.21	0.20	32	0.10	0.54
10	Manufacture of Pulp, paper and paper products	2.28	0.25	17	0.09	1.54
11	Manufacture of Printed matter and recorded media	2.39	0.27	21	0.06	0.53
12	Manufacture of Coke, refined petroleum products and nuclear fuels	2.53	0.19	10	0.18	0.87
13	Manufacture of Chemicals, chemical products	2.42	0.24	12	0.12	0.78
14	Manufacture of Rubber and plastic products	2.47	0.24	18	0.10	0.62
15	Manufacture of Other non-metallic mineral products	1.93	0.22	21	0.11	0.30
16	Manufacture of Basic metals	2.73	0.19	12	0.07	5.01
17	Manufacture of Fabricated metal products, except machinery and equipment	2.58	0.23	32	0.08	1.99
18	Manufacture of Machinery and equipment n.e.c.	2.29	0.25	22	0.07	1.33
19	Manufacture of Office machinery and computers	2.32	0.24	15	0.06	2.90
20	Manufacture of Electrical machinery and apparatus n.e.c.	2.44	0.24	18	0.07	1.27
21	Manufacture of Radio, television and communication equipment and apparatus	2.16	0.25	16	0.13	2.28
22	Manufacture of Medical, precision and optical instruments, watches and clocks	2.14	0.26	33	0.06	2.52
23	Manufacture of Motor vehicles, trailers and semi-trailers	2.87	0.23	19	0.07	2.09
24	Manufacture of Other transport equipment	2.04	0.28	23	0.06	2.48
25	Manufacture of Furniture; other manufactured goods n.e.c.	2.60	0.25	42	0.08	1.65
26	Recycling	2.83	0.22	21	0.06	16.25
27	Electrical energy, gas, steam and hot water	2.22	0.22	7	0.08	0.18

28	Collected and purified water, distribution services of water	1.97	0.21	9	0.04	0.45
29	Construction	2.24	0.29	22	0.10	0.76
30	Wholesale and retail trade	1.74	0.24	23	0.07	0.14
31	Hotels and restaurants	2.30	0.22	22	0.10	0.22
32	Transport, storage and communication	1.89	0.16	9	0.16	0.20
33	Financial Intermediation	1.57	0.32	9	0.08	0.13
34	Education services	1.44	0.71	24	0.04	0.07
35	Health and social work services	1.89	0.46	29	0.05	0.14
36	Other services	1.61	0.30	15	0.05	0.14

Source: Authors' calculations based on 2008 IZKA Izmir I-O Table.

* Employment multipliers show how labor demand (in terms of number of workers) would increase per 1 million Turkish Lira increase in output, where output increase is denoted in Turkish Liras of year 2008.