First Drafts for the Regional Macroeconomic Model of Győr and its agglomeration[1]

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Economic analysis of an area, exploring its macroeconomic relations using quantitative methods, can have a great importance on both national and regional levels. A region's total production, output, final demand and value added disaggregated to sectoral-territorial level are the key elements of local development and economic growth. A model describing their relations and expected values, suitable for regional forecasting and planning can be an essential tool for the development of the district, capable of elaborating its details and forecasting expected quantified effects. What kind of multiplicative effects can the development of the businesses, governance, investments, local, governmental and EU resources utilized in the area, appearance and disappearance of actors have on the economy of the region? How would the local economy be affected by the change of the final consumption's level and structure, the import demand of the consumption and production from outside the region or the country, or the increase of the export? What kind of impact could the technological changes or the shift of the supplier relations have on a region? Does the application of certain local tax allowances or other incentives have a positive net result for the governance and economy? Answers to these questions could be found with this model. The applications and the groups of potential users can be diverse. Calculations with the model can be utilized not only in impact studies, but also as a decision support tool for the actors of the regional governance or private sector. It can also be helpful for the assessment and enforcement of the bargaining power of businesses, non-profit organizations and consumers as well.

Keywords: regional macroeconomic model, regional input-output model, regional social accounting matrix.

This paper puts forth the foundations of a regional macroeconomic model describing the relations and settings of the key variables, preparing a multi-year research project. The result of this research could be an analytic framework, calibrated to Győr and its agglomeration, suitable for use in practice. Of course, the basic accounting model presented here can be adapted to other centre-periphery or multiregion situations, as well. The first section of the paper gives a brief theoretical background and outlines the logic of the model, the second and the third show the two main components of the proposed regional economic framework in details: the input-output table and social accounting matrix of the City and its agglomeration. Last sections consider some data collection, estimation and calibration issues, and give the agenda for further research.

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Theoretical background

The economic processes in the model are driven by the components of final demad: consumption of households, non-profit institutions and government; investment of private and government sector; and exports to other regions of the world (foreign countries and other domestic regions). Final demand is disaggregated to industries and so are output levels. What sectoral outputs satisfy occurrent final demand considering supply chains and intermediate consumptions between specialized firms of the modern economy? This question traces back to Leontief's input-output analysis and its regional applications (Miller, & Blair, 2009, Sargento, 2009, Hewings, & Jensen, 1986, Harrigan, McGilvray, & McNicoll, 1981, Calberg, 1978, Richardson, 1973, Reifler, & Tiebout, 1970, Moses, 1955, Chenery, 1953, Isard 1951). For an overview of the related literature see Koppány, Kovács, & Szabó (2014b).

Leontief's Nobel Prize worth mathematical analysis of the input-output table generates the famous production multipliers which can be used to predict how the total output (gross output, GO) and value added (gross domestic product, GDP) would react to a final demand change. These multipliers are calculated, updated and published for the regions of the United Stated in every 5 years with the famous RIMS II model (Ambargis, & Mead, 2012). In Hungary there were no such model calculations for thirty years (Rechnitzer, 1984).

Having a regional input-output table, the next question is: what happens to the additional incomes generated by production multiplication? Employees earn wages and salaries, and pay taxes from it, firms partly distribute their net incomes to the owners and partly back them to the company, this latter also generates tax payments. From these receipts governments finance their operations, consume and invest, and pay transfers to other actors adding to their disposable income. Households make consumption expenditures, and firms generate private investments. These flows of incomes between economic sectors and their transformation to final demand can be described by social accounting matrices (SAMs), in which all flows come from and go to somewhere. SAM is a strict double-entry book-keeping device to reconstruct macroeconomics from the recent fashion of reduced formulas to the systems of equations that actually grab economies as a whole with "no black holes" (Godley, & Lavoie, 2012). Regional SAMs are also lacking in Hungarian literature. Only a few models come from even the international stage (Martana, Evison, Lennox, & Manley, 2012, Kuhar, Golmenova, Erjavec, Kožar, & Cör, 2009, Punt, Pauw, van Schoor, Gilimani, Rantho, McDonald, & Chant, 2006, Bussolo, Chemingui, & O'Connor, 2003).

With tracing back final demand components from the social accounting matrix to the input-output table, that is linking this two main part of the model, we can build in not only Leontief's production effects but the Keynesian income-expenditure multiplication as well (Figure 1). This loop provides a full-integrated general equilibrium model, which can be described mathematically by a system of eugenvalue equations (Zalai, 2000).
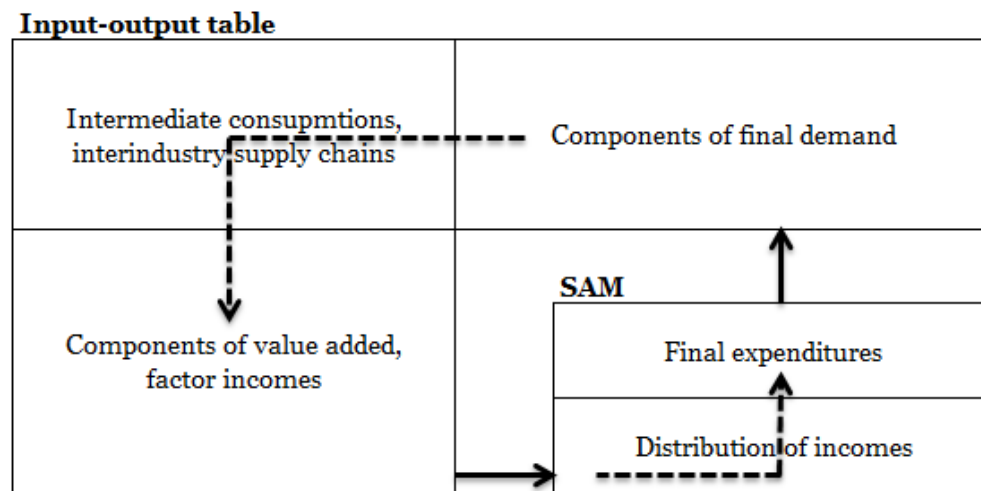
The model handles the flows between the City and the Agglomeration, and the centre and periphery of the region and other domestic regions or foreign countries. It means three flow directions. The proportion of an income or expenditure that stays or goes to the City is denoted by i (as internal or central regional economy), e (external regional economy or periphery) and m are for flows that stay or go to the Agglomeration and outside of the regional economy, respectively. In the subscripts we add the notation of the income or expenditure that the ratio refers to. The equation of $i+e+m=1$ evidently holds for all types of flows that have generated in the region. If the letters i or e are subscripts of a flow, then they denote the origin, if they are superscripts then they assign the destination region.

Regional input-output table of the City and its agglomeration

Table 1 shows the sketch of the multiregional input-output table of the City and its hinterland. The upper left part maps the relationships of the processing sectors 1, 2, .., n of the internal and external economies of the region. That's why the $2n \times 2n$ matrix is divided into four symmetric $n \times n$ submatrix. In the upper left submatrix industries of the city are suppliers and consumers too ($i_{IC_i} IC_i$); in the upper right city is the supplier and agglomeration is the consumer ($i_{IC_e} IC_e$); in the lower left agglomeration supplies and city consumes ($e_{IC_i} IC_i$); and in the lower right section industries of the agglomeration deliver to other industries in the hinterland ($e_{IC_e} IC_e$). IC_i and IC_e denote urban and suburban firms' intermediate consumptions, respectively.

Below the $2n \times 2n$ matrix of intermediate consumptions we summarize final use from domestic production and take imports in account. Imports for production purposes are split: the first cell is for import shipments into city's ($m_{IC_i} IC_i$), and the second one for agglomeration's industries ($m_{IC_e} IC_e$). Imports can come not only from foreign countries, but from other domestic regions too. Adding to final use from domestic production we can get total intermediate consumption of the regions' industries.

TABLE 1
Input-output (I/O) table of the City and its agglomeration (part 1, see also part 2 and 3)

Inputs ↓ / Outputs →			Producers as consumers							
			Industries in the City				Industries in the Agglomeration			
Producing industries			1	2	...	n	1	2	...	n
in the City	City	1	$i_{CIi}IC_i$				$i_{ICe}IC_e$			
		2								
		...								
		n								
in the Agglomeration		1	$e_{ICi}IC_i$				$e_{ICe}IC_e$			
		2								
		...								
		n								
Final use from domestic production										
Use of imported products and services from out of the region			$m_{ICi}IC_i$				$m_{ICe}IC_e$			
Total intermediate consumption										
Compensation of firms' employees			WF_i				WF_e			
Compensation of government's employees			WLG_i				WLG_e			
Firms' taxes on wages and salaries			TWF_i				TWF_e			
Government's taxes on wages and salaries			$TWLG_i$				$TWLG_e$			
Net local business taxes			$TLF_i - TRLF_i$				$TLF_e - TRLF_e$			
Net central indirect business taxes			$TCF_i - TRCF^i$				$TCF_e - TRCF^e$			
Consumption of fixed capital and undistributed profits			UP_i				UP_e			
Distributed profits			DP_i				DP_e			
Gross domestic product			Y_i				Y_e			
Total input (= gross output, GO)			GO_i				GO_e			

Input-output (I/O) table of the City and its agglomeration (part 2, see also part 3)

	Inputs ↓	Final demand			
		in the City		in the Agglomeration	
Outputs →		Final Consumption	Investments	Final Consumption	Investments
Producing industries					
in the City — 1, 2, ..., n		$i_{Ci}C_i$ $+i_{LGCi}LGC_i$	$i_{Ii}I_i$ $+i_{LGIi}LGI_i$	$i_{Ce}C_e$ $+i_{LGCe}LGC_e$	$i_{Ie}I_e$ $+i_{LGIe}LGI_e$
in the Agglomeration — 1, 2, ..., n		$e_{Ci}C_i$ $+e_{LGCi}LGC_i$	$e_{Ii}I_i$ $+e_{LGIi}LGI_i$	$e_{Ce}C_e$ $+e_{LGCe}LGC_e$	$e_{Ie}I_e$ $+e_{LGIe}LGI_e$
Final use from domestic production					
Use of imported products and services from out of the region		$m_{Ci}C_i$ $+m_{LGCi}LGC_i$	$m_{Ii}I_i$ $+m_{LGIi}LGI_i$	$m_{Ce}C_e$ $+m_{LGCe}LGC_e$	$m_{Ie}I_e$ $+m_{LGIe}LGI_e$

Input-output (I/O) table of the City and its agglomeration (part 3)

	Inputs ↓	Final Demand		Total output (=total use)
Outputs →		Central governement spending	Exports to other domestic regions or to foreign contries	
Producing industries				
in the City — 1, 2, ..., n		CGC^i+CGI^i	X^i	
in the Agglomeration — 1, 2, ..., n		CGC^e+CGI^e	X^e	
Final use from domestic production				GO_i+GO_e

At the bottom of Table 2 components of regional value added are listed in two columns: city and agglomeration. Because of accounting reasons and links to SAM, wages and salaries of firms' (WF_i, WF_e) and local government's employees (WLG_i, WLG_e), and related employers taxes ($TWF_i, TWF_e, TWLG_i, TWLG_e$) are handled separately.

Local and central business taxes paid by industries of the city and agglomeration are calculated as net values, decreased by subventions and transfers. Net local business taxes of urban firms is the difference of TLF_i (local tax of firms) and $TRLF_i$ (local transfers of firms). For central taxes we use C instead of L in the notations. In the case of central transfers letters i and e are in the superscripts. According to the notation rules set before it means that city (i) and outskirts (e) are the destination regions.

UP involves not only undistributed operating profits of industries but also amortization of fixed capital. DP denotes distributed profits to owners of the firms.

Adding up income components we can get added values of the city and agglomeration (Y_i, Y_e), and finally, gross outputs (GO_i, GO_e) as the sum of intermediate consumptions and values added.

We return to final demand components on the right hand side of the table after the overview of the social accounting matrix.

Regional social accounting matrix of the City and its agglomeration

Table 2 shows the regional social accounting matrix of the City and its agglomeration.

Compensations of employees appear with negative signs in the columns of the firms and local governments of the city and the suburbia in the row of labour incomes. Employers' taxes on wages and salaries are in the same columns in the row of taxes as outflows.

In the row of capital incomes and the columns of firms both distributed and undistributed incomes come up with negative signs. Undistributed profits involving amortization funds go to firms' capital columns as inflows with positive signs. (For simplicity only firms have separate current and capital columns in this basic version of the model.)

The model calculates on income mobilization, so that labour and capital incomes generated by local firms can go to local households and out of the district too. Incomes generated in the internal or external economy of the region can stay in the subregion of origin (for example $i_{WF_i}WF_i$ and $e_{WLG_e}WLG_e$); they can go to the other part of the region (from the city to the agglomeration, or vice versa, for example $e_{WF_i}WF_i$ and $i_{WLG_e}WLG_e$); and partly can go out of the region (for example $m_{WF_i}WF_i$ and $m_{WLG_e}WLG_e$).

As regional wages generated in the region can go out of the district, labour and capital incomes of the city and agglomeration can come from actors located out of the region too. WCG^i denotes citizens' wages that come from central or other regions' government sector, XW^e is for wages and XDP^e is for dividends paid by firms out of the region to households that live in the agglomeration. Since these are not parts of the examined region's GDP, they are not reported in the bottom of the input-output table.

Sectors → / Flows ↓	City Households	Firms Current flows	Firms Capital	Local government
Final consumption	$-C_i$	$+i_{Ci}C_i+i_{Ce}C_e$ $+i_{LGCi}LGC_i$ $+i_{LGCe}LGC_e$ $+CGC^i$		$-LGC_i$
Invesments		$+i_{Ii}I_i+i_{Ie}I_e$ $+i_{LGIi}LGI_i$ $+i_{LGIe}LGI_e$ $+CGI^i$	$-I_i$	$-LGI_i$
Intermedite consumption		$-(e_{ICi}+m_{ICi})IC_i$ $+i_{ICe}IC_e$		
Exports		$+X^i$		
Labour incomes	$+i_{WFi}WF_i$ $+i_{WFe}WF_e$ $+i_{WLGi}WLG_i$ $+i_{WLGe}WLG_e$ $+WCG^i+XW^i$	$-WF_i$		$-WLG_i$
Capital incomes	$+i_{DPi}DP_i+i_{DPe}DP_e$ $+XDP^i$	$-DP_i-UP_i$	$+UP_i$	
Transfers	$+TRCH^i+TRLH_i$	$+TRCF^i+TRLF_i$		$-TRLH_i$ $-TRLF_i+TRCG^i$
Taxes	$-TLH_i-TCH_i$	$-TWF_i-TLF_i-TCF_i$		$-TWLG_i$ $+TLH_i+TLF_i$
Net lending (+)/borrowing (-)	Σ	Σ		Σ

* income flows only that are going to or coming from the city or its agglomeration

Social accounting matrix (SAM) of the City and its agglomeration (part 2, see also part 3)

Sectors → Flows ↓	Agglomeration			
	Households	Firms		Local governments
		Current flows	Capital	
Final consumption	$-C_e$	$+e_{Ce}C_e + e_{Ci}C_i$ $+e_{LGCe}LGC_e$ $+e_{LGCi}LGC_i$ $+CGC^e$		$-LGC_e$
Invesments		$+e_{Ie}I_e + e_{Ii}I_i$ $+e_{LGIe}LGI_e$ $+e_{LGIi}LGI_i + CGI^e$	$-I_e$	$-LGI_e$
Intermedite consumption		$-(i_{ICe} + m_{ICe})IC_e$ $+e_{ICi}IC_i$		
Exports		$+X^e$		
Labour incomes	$+e_{WFe}WF_e$ $+e_{WFi}WF_i$ $+e_{WLGe}WLG_e$ $+e_{WLGi}WLG_i$ $+WCG^e + XW^e$	$-WF_e$		$-WLG_e$
Capital incomes	$+e_{DPe}DP_e + e_{DPe}DP_i$ $+XDP^e$	$-DP_e - UP_e$	$+UP_e$	
Transfers	$+TRCH^e + TRLH_e$	$+TRCF^e + TRLF_e$		$-TRLH_e$ $-TRLF_e + TRCG^e$
Taxes	$-TLH_e - TCH_e$	$-TWF_e - TLF_e - TCF_e$		$-TWLG_e$ $+TLH_e + TLF_e$
Net lending (+)/borrowing (-)	Σ	Σ		Σ

income flows only that are going to or coming from the city or its agglomeration

Sectors → Flows ↓	Central government / governments out of the region*	Private sector of other domestic regions / foreign countries*	Σ
Final consumption	$-CGC^i-CGC^e$	$+m_{Ci}C_i+m_{Ce}C_e$ $+m_{LGCi}LGC_i$ $+m_{LGCe}LGC_e$	0
Invesments	$-CGI^i-CGI^e$	$+m_{Ii}I_i+m_{Ie}I_e$ $+m_{LGIi}LGI^i$ $+m_{LGIe}LGI_e$	0
Intermedite consumption		$+m_{ICi}IC_i+m_{ICe}IC_e$	0
Exports		$-X^i-X^e$	0
Labour incomes	$-WCG^i-WCG^e$	$-XW^i-XW^e$ $+m_{WFi}WF_i$ $+m_{WLGi}WLG_i$ $+m_{WFe}WF_e$ $+m_{WLGe}WLG_e$	0
Capital incomes		$-XDP^i-XDP^e$ $+m_{DPi}DP_i+m_{DPe}DP_e$	0
Transfers	$-TRCH^i-TRCH^e$ $-TRCF^i-TRCF^e$ $-TRCG^i$ $-TRCG^e$		0
Taxes	$+TCH_i+TWF_i+TCF_i$ $+TWLG_i+TCH_i$ $+TWF_i$ $+TCF_i+TWLG_i$		0
Net lending (+)/borrowing (-)	Σ	Σ	0

income flows only that are going to or coming from the city or its agglomeration

The long parametric formula in the cell of civic households' labour incomes reflects that citizens share with i_{WF_i} proportion in wages and salaries paid by firms located in the city, i_{WF_e} proportion in wages and salaries paid by firms located in the periphery, i_{WLG_i} proportion in wages paid by local government, and i_{WLG_e} proportion in wages paid by government sector of the agglomeration. Of course, households in the City can receive labour incomes from

business and government sector out of the region too (XW^i, WCG^i). In the agglomeration the same items can be found with ratios e instead of i's, and vice versa.

The m proportions of incomes generated in the examined area go to the economy out of the region with positive signs (for example $m_{WF_i}WF_i$, $m_{WLG_i}WLG_i$ and $m_{DP_e}DP_e$) in the two related columns of the table (private sector of other domestic regions/foreign countries; central government/governments out of the region).

The SAM has separate rows for taxes and transfers. Firms pay central and local business taxes in addition to taxes on wages and salaries. Local taxes go to local governments, and central taxes flow to central government. Households pay both central and local taxes too. Transfers occur with positive signs in the columns of firms and households, and with negative signs in the columns of the emitters. In the column of local governments we account on funds coming from central government (*TRCG*).

Households make their consumptions from their disposable income. Beside the households also government sector has consumption expenditures (*LGC*, *CGC*), and investment expenses (*LGI*, *CGI*) too. Investments (*I*) involve replacement and expansion of fixed capital and changes in inventories.

The proportions i, e and m are used for components of final use generated in the region. For example, the consumption expenditures of households in the city (C_i) generates demand with a portion of i_{C_i} for products and services of firms that are located in the city, with a portion of e_{C_i} for products of firms that operate in the agglomerations, and with a portion of m_{C_i} for imported goods.

In the columns of firms' current flows both the offset of materials, goods and services between the city and agglomeration, and the intermediate consumption going to and coming from out of the region are indicated. It makes a full integration of regional firms' receipts and outlays, and a correct accounting of spatial GDP of the city and the agglomeration. On the one hand, intermediate goods coming from other territories mean imports for the given location. The offset of these flows ought to be taken into account with a negative sign when calculating GDP. On the other hand, the offset of materials, goods and services flowing between the city and its agglomeration produce export receipts to the seller in a spatial manner same as the exports to extra-regional actors (X^i, X^e). Thus the sums of current flows in the first four rows of business sectors give the GDP of the city and the agglomeration by the spending approach.

Tanks to double-entry book-keeping all flows appear twice in the same row: firstly with a negative, and secondly with a positive sign. Hence the sum of every single row is zero. The sums of columns result in the financial position (net lending or borrowing) of the sectors.[3]

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[3] We could also build in the columns of banking and financial system as a separate sector, several financial assets (money, deposits, loans, treasury bills and bonds, corporate securities etc.) and real capital as rows. Hence the matrix would show not only the income generation and distribution, it would also become the stock-flow consistent accounting table of changes in assets. In this improved version column sums would be zeros too. Economists of the Cambridge Post Keynesian School and the Theory of Monetary Circuit highlight this great opportunity, which can give more complete and precise description of modern monetary economies (see for example Godley-Lavoie, 2012, Dos Santos–Zezza,

The last, summing row of the matrix also adds up to zero as the equilibrium condition of the economy.

Finally, components of final demand are returned to the left hand side of the regional input-output table. This segment of the table is broken down to three main parts: city, agglomeration and extra-regional territories. Within the final use of the city and the agglomeration consumptions and investments are separated, while flows that go out of the region are organized according to the receiver sector (government, business). All components of expenditures occurred in the social accounting matrix can be classified and inserted to final use columns of the input-output table.

Full list of model variables and parameters are listed in Appendix.

Data collection, estimation and calibration issues

The basic model discussed here is only a first draft, which has been tested with arbitrary parameters and proven to be suitable for regional macroeconomic modelling. Calibrations to Győr and its agglomeration are in progress. Motivations to choose this region for empirical work originate in author's strong attachments to City and the support of TÁMOP-4.2.2.A-11/1/KONV-2012-0010: Regional Automotive District of Győr as a New Direction and Tool of Area Development project, which have set the research going, and the Bolyai Research Scholarship of Hungarian Academy of Sciences providing the support to push on.

Although a full data collection and calibration couldn't be accomplished with the resources and time available, loading the system with real data and development an underlying database using financial reports of resident companies and data from household surveys have started off.

Tóth (2013) have set out the spatial frontiers of the analysis according to the Local Labour System of Győr, which contains 85 towns and villages from Győr-Moson-Sopron, 2 from Komárom-Esztergom and 7 from Veszprém County. Although the region has strong labour market relations also to Slovakia, to reduce difficulties of data collection and modelling we reckon the related Slovakian area as extra-regional territory.

The topmost obstacle to get over is that there are no official statistical data collection and publication, hence no structured secondary data available for the region. Therefore we have to build up our own database through surveys, arrangements and estimates using fractional or higher aggregated information of Central Statistical Office of Hungary, fragmented public regional databases and financial statement data, which we have purchased from Dun, &Bradstreet Hungária Kft.

Using these data we have made an estimation of regional sectoral disaggregated GO, GDP and incomes (Dusek, Koppány, Kovács, & Szabó, 2015, Koppány, Kovács & Szabó, 2014a) and made the first calibrations of the three-industry version of the regional input-output table of Győr and its agglomerations called GyőrI/O (for details see Koppány, Kovács, & Szabó, 2014c).

2004, Zezza, 2004, Graziani, 2003, Lavoie, 2001). A Hungarian application of this kind of models can be found in Koppány (2005).

Further research

The agenda for further research includes expanding the number of industries to 25-30 in the input-output table, calibrating both I/O and SAM blocks of the model based upon an own-developed hybrid technique, working out the behavioural equations, performing a thorough mathematical analysis of the system, and develop the computer programs and sites that provides data suppliers to use the model to detect and forecast their regional economic effects in Győr and its agglomeration.

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Appendix: variables and parameters of the model

i	the portion of incomes or expenditures that stay in or go to the City
e	the portion of incomes or expenditures that stay in or go to the Agglomeration
m	the portion of incomes or expenditures that flow out of the Region
WF_i	wages and salaries paid by firms located in the City
WF_e	wages and salaries paid by firms located in the Agglomeration
WLG_i	wages and salaries paid by local government of the City
WLG_e	wages and salaries paid by local governments of the Agglomeration
WCG^i	wages and salaries paid by central or local governments out of the Region to employees that live in the City
WCG^e	wages and salaries paid by central or local governments out of the Region to employees that live in the Agglomeration
XW^i	wages and salaries paid by firms located out of the Region to employees that live in the City
XW^e	wages and salaries paid by firms located out of the Region to employees that live in the City
DP_i	distributed profits paid by firms located in the City
DP_e	distributed profits paid by firms located in the Agglomeration
UP_i	undistributed profits of the firms located in the City
UP_e	undistributed profits of the firms located in the Agglomeration
XDP^i	distributed profits paid by firms located out of the Region to the owners that live in the City
XDP^e	distributed profits paid by firms located out of the Region to the owners that live in the Agglomeration
$TRCH^i$	transfers paid by central government to the people that live in the City
$TRCH^e$	transfers paid by central government to the people that live in the Agglomeration
$TRLH_i$	transfers paid by local government of the City to the people that live in the City
$TRLH_e$	transfers paid by local governments of the Agglomeration to the people that live in the Agglomeration
$TRCF^i$	transfers paid by central government to the firms located in the City
$TRCF^e$	transfers paid by central government to the firms located in the Agglomeration
$TRLF_i$	transfers paid by local government to the firms located in the City
$TRLF_e$	transfers paid by local government to the firms located in the Agglomeration
$TRCG^i$	transfers paid by central government to the local government of the City
$TRCG^e$	transfers paid by central government to the local governments of the Agglomeration
TLH_i	local taxes of the households that live in the City
TCH_i	central taxes of the households that live in the City
TLH_e	local taxes of the households that live in the Agglomeration
TCH_e	central taxes of the households that live in the Agglomeration
TWF_i	employers' taxes on wages paid by firms located in the City
TLF_i	local taxes paid by firms located in the City
TCF_i	central taxes paid by firms located in the City

TWF_e	employers' taxes on wages paid by firms located in the Agglomeration
TLF_e	local taxes paid by firms located in the Agglomeration
TCF_e	central taxes paid by firms located in the Agglomeration
C_i	final consumption expenditures of households that live in the City
C_e	final consumption expenditures of households that live in the Agglomeration
LGC_i	final consumption expenditures of local government of the City
LGC_e	final consumption expenditures of local governments of the Agglomeration
CGC^i	final consumption expenditures of central or local governments out of the Region that go to the City
CGC^e	final consumption expenditures of central or local governments out of the Region that go to the Agglomeration
I_i	investments of firms located in the City
I_e	investments of firms located in the Agglomeration
LGI_i	investments of local government of the City
LGI_e	investments of local government of the Agglomeration
CGI^i	investments of central or local governments out of the Region that go to the City
CGI^e	investments of central or local governments out of the Region that go to the Agglomeration
IC_i	intermediate consumption of firms located in the City
IC_e	intermediate consumption of firms located in the Agglomeration
X^i	export receipts of the City (exports to foreign countries or other domestic regions)
X^e	export receipts of the Agglomeration (exports to foreign countries or other domestic regions)