

## DESARROLLO TECNOLÓGICO

### Overview of Heavy Metal Pollution Issue in Rivers in the Barada Basin, Syria.

Rimah Melhem and Yoshiro Higano

### Role of information technology as a contributor of economic growth.

Jorma Pietala & Kristiina Coronen

### Competitividad global y reestructuración económica y laboral en Guadalajara, 1987-2000.

Salvador Carrillo Regalado

### An Empirical Study on Shopping Behavior in the ICT Era

### -Toward Demand Forecast of Shopping-related Trips in Japan-

Tokio Otsuka, Hiroyuki Someya, Toshiya Jitsuzumi, Hitoshi Mitomo

## Overview of Heavy Metal Pollution Issue in Rivers in the Barada Basin, Syria

Rimah Melhem\* and Yoshiro Higano\*\*  
Tsukuba University, Japan  
[shintaro@jrsai.tsukuba.ac.jp](mailto:shintaro@jrsai.tsukuba.ac.jp)

### Abstract

Manufacturing industries are blooming rapidly in Barada Basin carrying high risk to environment and human health due to generating huge amounts of heavy metals to environmental media, particularly rivers. Few studies show that concentrations of chromium, cadmium, and lead exceed the standards in down streams of rivers.

In this paper, by developing a mathematical model that describes the interrelation between the ecological and economic systems, we run simulation to estimate amount of Cr, Cd, Pb generate from manufacturing industries annually under optimal economic condition. The results show that high concentration of these contaminants are discharged to rivers annually urging for risk assessment of these metals on environment and human health in further studies.

### 1. Introduction

Barada basin is the biggest human assembly in Syria. Thus, various socio-economic activities take place in the basin. Government policy enforcement to enlarge industrial investments leads to haphazard increase of the number of firms to satisfy the market demand beside random discharged of waste. All the industrial wastewater is discharged directly to environmental media without any kind of treatment. Beside the huge amount of organic pollution contaminate the water bodies, Barada and Awaj Rivers, considerable amount of heavy metals generated also from specific manufacturing such as, textile, chemical, and metal industries. That makes surface water pollution a severe problem in the basin [8] [20].

There are more than 12,000 factories ranked from micro-scale with one worker to large-scale firms with hundreds of workers belong to private and public sectors. Number of chemical, metal, and textile manufactories are approximately 40% of total factories but they produce huge load of heavy metals especially, chromium, cadmium, and lead. Chromium generate mainly from leather processing, metal calving and battery production. Moreover, cadmium is discharged from smelters, iron and steel plants,

and battery production. While the main sources of lead are smelting, and processing of lead and lead-containing metal ores [11] [22].

Those industries usually assemble in urban areas in downstream of rivers. So they still keep upstream quite far from industrial pollution. However, downstream particularly the Barada River, is remarkably polluted. The most highly contaminated area that worth to be mentioned is the Zablatani tannery district in the eastern district of the city of Damascus. This area consists of several type of industries, but the most critically it includes a large cluster of tanneries. Leather processing is carried out in around 160 private tanneries and four public ones. The estimated wastewater described in table 1[20]. It obviously shows that significant pollution load is generated from this area much more that the allowable guideline for industrial wastewater to discharged to sewage network. It is important to notice the amount of untreated chromium discharged directly to environment is around 0.6t/day. The concentration of chromium in the wastewater reaches 100mg/l where the standard is 5mg/l. More than twenty times of allowable concentration go to river everyday. That situation urge for immediate action toward reducing this enormous amount of Chromium.

Table 1: Estimated Wastewater Discharges and Characteristics for tanneries in Zablatani[20]

	Concentration(mg/l)	Mean Load(t/d)	Syrian standard to discharged to seweg(mg/l)
BOD	1200-1500	16	1000
COD	3000-4000	43	3000
TN	430-1100		
TP	6-16		
Chromium	70-100	0.6	5

Besides, In 1998 the first sewage treatment plant in Damascus started operation. It is located at Adra, 20km east the city. The treated water are planned to use for irrigation for around 15,000ha through concrete canals [9]. The plant has good biological treatment but there is no special treatment for inorganic matters specially heavy metals. It is easy to guess the tragedy from such issue. First, these inorganic frequently cause malfunction of the plant, hence the wastewater are discharged lastly without any treatment, so often. That implies huge load of pollution released to final destination. Second, The treated water used for irrigation transmitting massive amount of heavy metals to plant tissues. Analysis undertaken by Ministry of Environment on the leaves of several plants shows that heavy metals exist in relatively high concentration (Table 2). That carries great impact on inhabitants and human health [22].

Table 2: Heavy metals in Plants' leaves[10]

	Cadmium ( ppm )		Chromium ( ppm)		Lead (ppm)	
	Peak	Typical	Peak	Typical	Peak	Typical
Corn	0.038	0.032	1.9	1.8	2.1	1.72
Lettuce	0.1	0.07	8.7	4.6	0.6	0.26
Mint	0.36	0.12	13.05	7.4	0.24	0.09
Parsley	0.13	0.07	4.7	3.1	2.6	0.57
Sorrel	0.96	0.17	42.46	14.5	3.0	0.8

According to tested samples in the laboratory of municipalities affiliated to Ministry of Local Administration, Heavy metal does present in surface water, ground water and sediment. However, surface water samples show very high concentrations of Chromium, cadmium and then lead. These concentration is much over than WHO, Syrian for drinking water and FAO standard for irrigation, in the downstream, especially Barada River. It shows significant deterioration of Barada River water. Since sampling have been started in 1978, the concentration of chromium, cadmium and lead in crease 10-15 times. Fortunately, river water is not used for drinking water otherwise, outspread of water

poisoning might have happened long time ago. The peaks detected were 40.39 mg/l for Cr, 0.506 mg/l for Cd, and 0.272 mg/l for Pb in 1998 at Zablatani, Damascus and Harasta, Norht Douma.

In this paper, we analyzed the problem from point-source of pollution. For this purpose, we develop a mathematical model based on Principle of Material Balance and optimization criterion to describe the behavior of pollutants dynamically in the environment on one hand and the market condition and its effects on environment on the other hand. For examining the interrelation between the two system, it involved estimating emission coefficients from each type of manufacturing using specific data and guidelines [18][21]. After that, simulation was run for 10 terms of time using LINGO software and the results are discussed to fulfill the paper objectives. By this simulation we could achieve the following:

1. Estimate the amount of specially serious heavy metals, Cr, Cd, Pb, generate from each type of manufacturing sectors,
2. Predict the effect of economic growth on increasing the load of pollution in long-term,
3. Study the contribution of pollution loads among districts in study area,
4. Determine the necessity of risk assessment of such metals on environment and human health in particular.

## 2. The model

We have developed model to analyze comprehensively the most critical pollutants in the study area including organic pollutants beside heavy metals for each activity in each zone. However in this paper the results focus only on heavy metals to correspond with the paper objectives.

### 2-1 The model variables and definitions

The study area includes the drainage basin of each The Barada River and The Awaj River. Administratively, it includes two provinces, Damascus and Rural Damascus. The province of Rural Damascus affiliates six districts. Two of these districts are located in The Barada Drainage Basin, two are located in Awaj Drainage Basin and the other two lie on both basins as shown in table 3.

Table 3 Flow of water in the sub-district affiliated to both rivers[16].

Province	District	Sub-District	Water flow
Damascus City			Barada River
Damascus Rural	Damascus Rural Center	Babilla	Barada River
		Jaramana	Barada River
		Erbeen	Barada River
		Al-Kissweh	Awaj River
		Kafar Batna	Barada River
		Mleiha	Barada River
	Al-Tal	Al-Tal Center	Barada River
		Rankus	Barada River
		Sednaya	Barada River
	Darya	Darya Center	Awaj River
		Suhnaya	Awaj River
	Douma	Douma Center	Barada River
		Harran Al-Awamid	Barada River
		Harasta	Barada River
		Al-Dmir	Awaj River
		Al-Nashabieh	Barada River
		Al-Ghozlaniy	Awaj River
	Zabadani	Zabadani Center	Barada River
		Dimas	Barada River
		Serghaya	Barada River

		Ain Al-Fijeh	Barada River
		Madaya	Barada River
	Katana	Katana Center	Awaj River
		Al-Haramoun	Awaj River
		Saasa	Awaj River

The study area contains ten zones nine of them are divided according to the water flow in the sub-districts to each river. There is single treatment plant for treating Damascus city wastewater, Adratreatment plant. The treated water is used for irrigation in zone 5 (Table 4).

Table 4: Classification of zones

Zone Index	Zone
1	Zabadani
2	Damascus
3	Al-Tal
4	Damas-Rural
5	Irrigation project
6	Douma-North
7	Katana
8	Darya
9	Al-Kissweh
10	Douma-South

In The Barada Drainage Basin zone 1, 2,3,4,5, and 6 are located. However, 1,2,5,6 only are located along the river. In The Awaj Drainage Basin zone 7, 8,9,10 are located but zone 8 is not located along the river. Zone 4, 9 are affiliated to same district and the same for zone 6, 10.

The industrial activities are classified as shown in table 5.

Table 5: The classification for industries

Index	Industry
1	Agriculture
2	Food
3	Textile
4	Chemical
5	Metal and electric devices
6	Other manufacturing
7	Other

The selected pollutants which are controlled in the simulation are as follows:

Table 6: The classification in the pollutants

Index	Pollutant
1	TN
2	TP
3	BOD
4	Chromium
5	Lead
6	Cadmium

## 2-2 Model objectives

1. Clarify the multi-sector interrelationships and determine the characteristic of ecosystem and socioeconomic structure in each zone [2].
2. Estimation of pollutant distributions in activities, particularly manufacturing and the chronic interrelation between production and pollution.
3. Estimation of pollutant distribution in zones
4. Maximizing the GRP as indicator of welfare in zones and examine the correlation ratio between amount of pollution and GRP in order to conduct the economic efficiency of an introduced policy in further steps of our research.

## 2-3 Model specification

Since previous studies shows that river water is the most polluted among environmental media beside the limitation of data, the model is restricted to interrelation between socioeconomic activities and pollution of rivers, neglecting the quality of ground water and sediment.

### 2-3-1. Total pollution

Based on Principle of Material Balance [4][5][6][7], the total pollution flows to each The Barada and Awaj Rivers is calculated by the pollution generates from each zone

$$\text{[Blank Box]} \dots\dots\dots(1)$$

[Blank Box] : The total amount of pollutant p flowing to Barada River at time t.

[Blank Box] : The total amount of pollutant p flowing to Awaj River at time t.

In order to know which type of socioeconomic activity participate the most in the contamination discharged in each zone, the total amount of pollutants generate from each zone is calculated as follows:

$$\text{[Blank Box]} \dots\dots\dots(2)$$

[Blank Box] : The amount of pollutant p generates from total industrial activities in zone i at time t.

[Blank Box] : The amount of pollutant p generates from households in zone i at time t.

$$\text{[Blank Box]} \dots\dots\dots(3)$$

$$\text{[Blank Box]} \dots\dots\dots(4)$$

[Blank Box] : Total amount of pollutant p generated in zone i at time t.

[Blank Box] : Total production of industry j in zone i in monetary term at time t.

[Blank Box] : Population of zone i at time t.

[Blank Box] : Emission coefficients to rivers of pollutant p for industry j (in zone i) and household respectively.

However, in zone 2 where Damascus City located the domestic and industrial wastewater is treated in Adra treatment plant using activated sludge. This biological treatment reduces BOD, TN, and TP but can not treat heavy metals carried by industrial wastewater. Those amounts of pollutants are calculated in the following equation:

$$\text{[Blank Box]} \dots\dots\dots(5)$$

while [Blank Box]

Besides, in zone 5 the treated wastewater of Adra plant is used for irrigation so the total pollution generated is, in addition to the contamination generated from socioeconomic activities in that zone, and the amount of pollutants carried by treated water, especially heavy metals, as shown in the following equation:

$$\text{[Blank Box]} \dots\dots\dots(6)$$

**2-3-2. Water balance and water quality**

**Barada River:**

The following equations calculate the water balance at border of zones carried by Barada River as a basis for calculation the concentration of pollutants at those borders. That concentration is very important variable since the aim of proposed policy will be to decrease the pollutants concentration to meet the standards:

$$\text{[Redacted]} \dots\dots\dots(7)$$

$$\text{[Redacted]} \dots\dots\dots(8)$$

$$\text{[Redacted]} \dots\dots\dots(9)$$

$$\text{[Redacted]} \dots\dots\dots(10)$$

$Q_1$ : Flow of The Barada River at the border between zones 1&2, 2&5, and 5&6 respectively.

$Q_2$ : Amount of treated water in the Adra treatment plant.

$Q_3$ : Amount of wastewater flow to Barada River in zones 1,2,3,5 respectively.

The following variables are exogenous because according to data available, they can not be expressed dynamically:

$Q_4$ : Amount of spring water flows to Barada River.

$R_1$ : Annual average rainfall in zones 1, 2, 5 respectively.

$R_2$ : Annual ground water pumped from wells in zone 1, 2, 5 respectively.

$R_3$ : Annual water used for irrigation in zones 1, 2, 5 respectively.

$R_4$ : Annual average evaporation in zones 1, 2,5 respectively.

\*  $R_5$ : Annual average amount of drinking water pumped from the Figeih Spring to Damascus City .

The following equations calculate the water quality for each pollutant discharged to BaradaRiver at the border between zones based on simple dilution model [1]. The concentrations of the pollutants at these points affect the evaluation of the water quality:

$$\text{[Redacted]} \dots\dots\dots(11)$$

$$\text{[Redacted]} \dots\dots\dots(12)$$

$$\text{[Redacted]} \dots\dots\dots(13)$$

$C_1$  Quality of water at the border between zones 1&2, 2&4, 4&5, and 5&6 respectively.

$K_1$ : Natural purification coefficients for the zones 1,2,5 respectively.

The concentration of pollutants after treatment is very essential to examine since this water used for irrigation. The following equation calculates the pollutant concentrations after released from the treatment plant.

$$\text{[Redacted]} \dots\dots\dots(14)$$

**Awaj River:**

$$\text{[Redacted]} \dots\dots\dots(15)$$

$$\text{[Redacted]} \dots\dots\dots(16)$$

$Q_7$ : Flow of The Barada River at the border between zones 7&9 and 9&10 respectively.

$Q_8$ : Amount of spring water flows to Awaj River.

$R_7$ : Annual average rainfall in zones 7,9 respectively.

$R_8$ : Annual ground water pumped from wells in zone 7,9 respectively.

$R_9$ : Annual water used for irrigation in zones 7,9 respectively.

: Annual average evaporation in zones 7,9 respectively.  
 : Amount of wastewater flow to Barada River in zones 7,8,9 respectively.

.....(17)

.....(18)

Quality of water at the border between zones 7&9, and 9&10 respectively.

: Natural purification coefficients for the zones 7,8,9 respectively.

The amount of wastewater

.....(19)

**2-3-3. The economic model**

Since the economic data is very limited the economic model is simple one.

We assume that the relation between population and number of workers in each zone is constant by the time since we examined the correlation between number of workers and percentage of working population from year 1990 to 2000 and it was almost constant:

.....(20)

: The percentage of working population in zone i.

: Demand for new working population due to new investment.

.....(21)

The following assumption based on Harrod-Doman production function [23]. An increase of production requests an increase of labor:

.....(22)

Labor force required per production unit in industry j.

Also the demand of the capital:

.....(23)

: The capital required per production unit in industry j

: Capital stock of industry j in zone i at time t.

Capital is accumulated by investment in each industry, in each zone at each time period:

.....(24)

: The depreciation rate.

: Investment in zone i, industry j at time t.

The gross regional product (GRP) for any zone is the sum of total production (all industries) multiplied by the value added of production in each industry:

.....(25)

: Gross regional product of zone i at time t.

: The value added ratio in industry j and zone i.

On the other hand, the gross regional product equal to consumption plus investments and net transfers (subsidies to or borrowing from) to other zones:

.....(26)

The consumption is the population of every zone times the consumption per capita:

.....(27)

: Consumption per capita.  
 : The consumption in zone i at time t.

The objective function

s.t equation (1)

### 3. Simulation results

We run simulation for 10 terms of time from year 2000 using software called LINGO.

#### 3-1. Total pollution to rivers

Results show that amount of chromium, cadmium, and lead is increasing steadily along the years. That corresponds with the stable economic growth of the basin (Table 7).

Table 7: Amount of heavy metals in rivers along simulation years

Time	Barada River			Awaj River		
	Cr(t/y)	Cd(kg/y)	Pb(kg/y)	Cr(t/y)	Cd(kg/y)	Pb(kg/y)
2000	295.2945	563.8889	657.9635	1.529128	145.1403	109.8453
2001	310.0592	592.0833	690.8616	1.605584	152.3973	115.3376
2002	325.5622	621.6874	725.4047	1.685863	160.0172	121.1045
2003	341.8403	652.7718	761.6749	1.770157	168.0181	127.1597
2004	358.9323	685.4104	799.7587	1.858664	176.419	133.5177
2005	376.8789	719.6809	839.7466	1.951598	185.2399	140.1936
2006	395.7229	755.665	881.7339	2.049178	194.5019	147.2032
2007	415.509	793.4482	925.8206	2.151636	204.227	154.5634
2008	436.2845	833.1206	972.1117	2.259218	214.4384	162.2916
2009	458.0987	874.7767	1020.717	2.372179	225.1603	170.4061

It is conducted that chromium is discharged in highest amount comparing to cadmium and lead. Besides, is higher in Barada River because most of the tanneries, which generate huge amount of chromium is concentrated along Barada River (Figure 1)

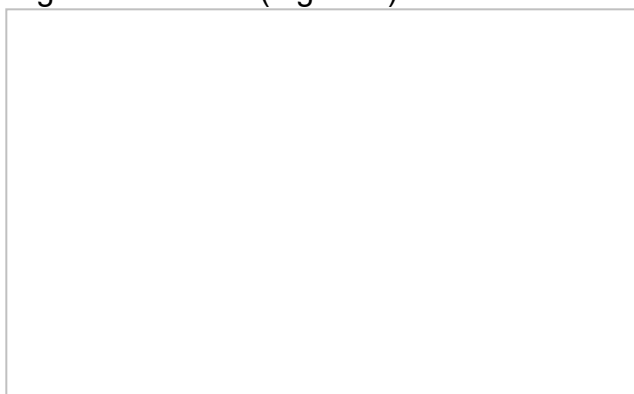


Figure 1: Amount of chromium flow to rivers

For the case of cadmium and lead is discharged to Barada River in higher quantities than in AwajRiver (Figure 2&3)



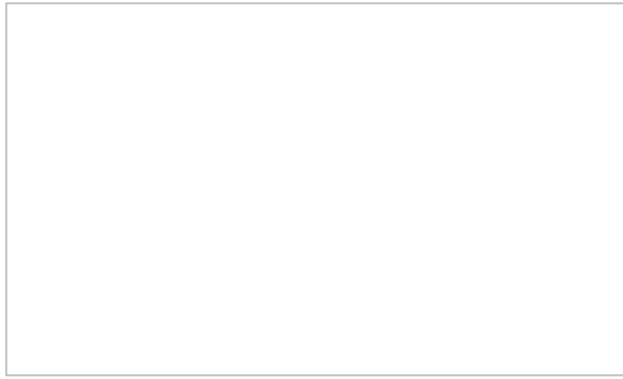


Figure 2: Amount of cadmium and lead flow to Barada River



Figure 3: Amount of cadmium and lead flow to Awaj River

### 3-2. Water quality

Water quality results are very important to demonstrate the change of metal concentration along rivers, particularly in the border points between zones thus it show the participation of each zone in the contamination of the river.

**3-2-1 Barada River:** Dissimilar to down stream, upstream is not polluted since the industrial activities in zone 1 and 3 are few and limited to food industry and scattered firms for assembling devices. However, in zone 4 the leather, smelting, battery production, and other cause to increase of amount of heavy metals but still not exceed the standard (Figure 4).

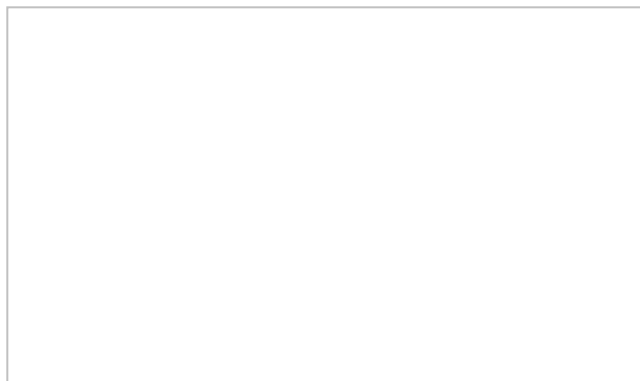


Figure 4: Concentration of pollutants in the border between zones 4&5

For zone 5 with decrease of water flow beside its own manufacturing and pollution received from zone 2 the concentration increase around ten times more than allowable limits as shown in Figure 5 and 6.



Figure 5: Concentration of chromium in the border between zones 5&6



Figure 6: Concentration of cadmium and lead in the border between zones 4&5

**3-2-2 After Adra treatment plant:** since this plant does not contain any treatment for heavy metals, again these pollutants discharged in extremely high concentrations ( Figure 7&8). Unfortunately, the treated water is used for irrigating green vegetables and crops, which carry obviously tremendous danger for inhabitants and directly to human health in the whole study area since zone 5 the main supply for vegetables for other zones. For this reason risk assessment for these chemical on human health must be undertaken [1][24]

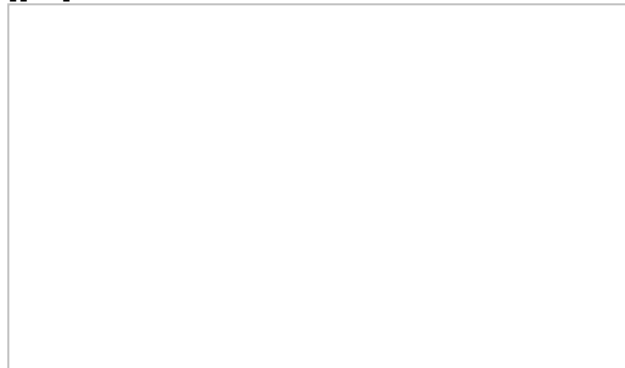


Figure 7: Concentration of chromium after discharged from treatment plant

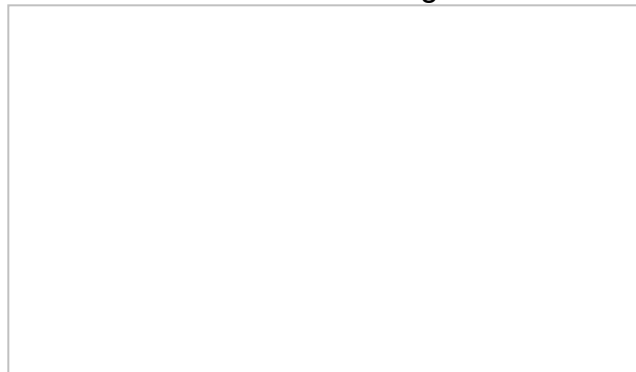


Figure 8: Concentration of cadmium and lead in the border between zones 4&5

**3-2-3 Awaj River:** The situation in Awaj River not serious comparing to Barada River since the industrial activities not heavily concentrated along this river. Upstream the concentration is almost zero

and downstream (zone 9& 10) the concentration less than the standard. However, according to MLA few samples did show concentration in the downstream more than standard [14]. This is significant indicator that chemical accumulation is taken place in the surface water and the results we demonstrate here is just display how much heavy metals generate annually though the real condition may show higher number.

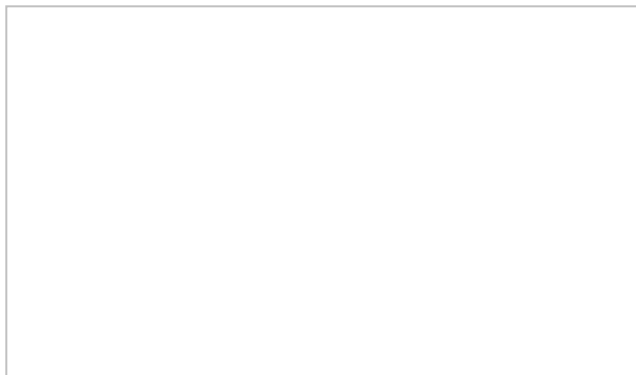


Figure 9: Concentration of pollutants in the border between zones 9&10

### 3-3. Manufacturing contribution

Since the demand of investment is equal (according to model specification) among the manufacturing industries, the contribution of generating pollutants is constant along simulation years. However, this contribution varies among zones since the industrial activities are different in these zones. This dissimilarity is reflected in the model with two variables: production and investment and one parameter: emission coefficients from industrial activities. In case of production and investment data for initial year is available but for the emission coefficients we had to estimate those using specific data and guidelines. These coefficients widely differ in the zones due to variety of manufacturing types. For instant, under textile industry there are many sub-sectors such as, dying, leather, or just cotton processing. Leather processing generate huge amount of chromium and lead while cotton dealing produce just BOD. Getting directly to the point, the range of pollutant quantity among zones is very important to be determined in order to introduce specific policy measures for each zone. Ignoring that leads to equal sharing of responsibilities, this means unfair sharing of mitigation cost among in these zones.

Getting back to the results, in case of chromium, textile industry is the main contributor in zones 2,4,5, and 8 while chemical industry take all part in zone 3 and 10 and 55% of zone 6. In zone 9 and 45% of pollution in zone 6, the contribution is from metal industry as shown in Figure 10.

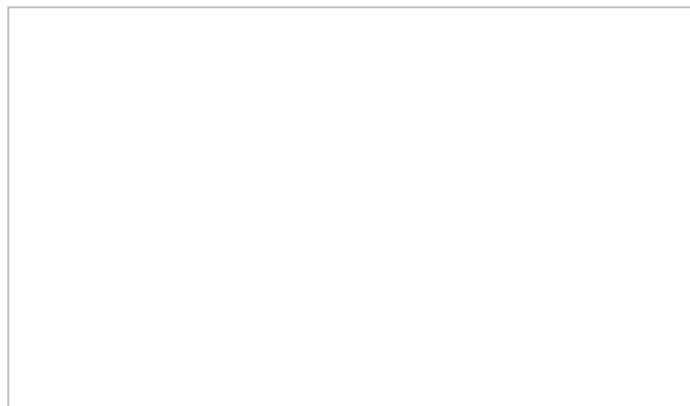


Figure 10: Contribution of manufacturing industries in generating chromium

Figure 11 shows that main source of lead in zone 2 and 8 from textile while 50% in zone 4 and less than 40% in zone 5. Moreover, chemical industry in the only source of lead in zone 3 and 10 and 70% in zone 6, while metal is the only contributor in zone 9.

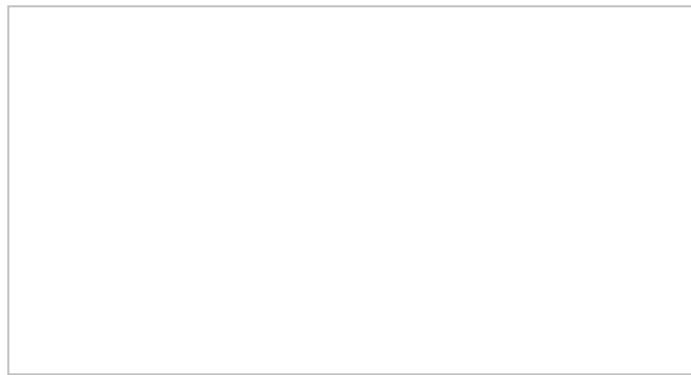


Figure 11: Contribution of manufacturing industries in generating lead

In case of cadmium chemical is the main contributor in zone 3 and 10, while metal industry has the same role in zone 4, 6, and 9 and 55% in zone 8. For textile industry, it is the main source in zone 2 and less than 50% in zone 8 (Figure 12)

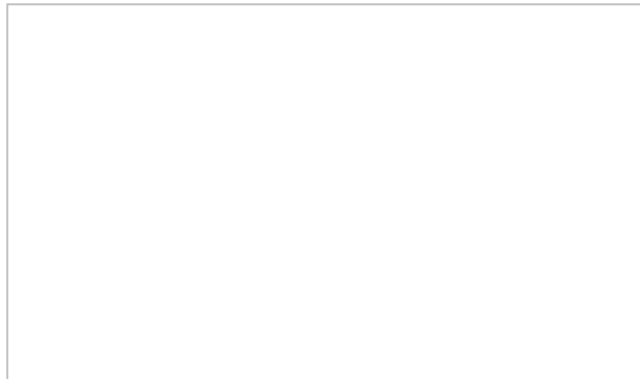


Figure 12: Contribution of manufacturing industries in generating cadmium

#### 4. Conclusion

In this paper we analyze the problem of heavy metals generated from manufacturing industries as point-source of pollution by running simulation for mathematical model to determine the amount of chromium, cadmium and lead discharged and clarify the contribution of these pollutants by sectors and zones. The results show that the amount of pollutants varies among sectors and zones. However, Barada River is highly polluted especially in downstream and zone 2 contributes the most of such contamination. Moreover, the chromium is the most serious element since it concentrates in excessive quantity, particularly in zone 5 where the water in this area used for irrigating vegetable and crops, which may high risk to human health.

Consequently risk assessment of these pollutants on human health is definitely required to investigate the degree that inhabitants in the study area are in danger, number of people under defined levels and types of risk are exposed, and predict mortality cases due to cancer. This should be carried out considering the data available in order to reduce uncertainty in assumption as much as possible because depending on the assessment results it would be decided the necessity of risk management.

As a conclusion, the model can be considered conceptual since the results we obtain correspond as an overview with previous studies and present samples. Precisely, it did provided a detailed quantitative records and more specific qualitative information can be a basis for further studies.

The simulation results are essential basis for further steps because:

1. Estimating the amount of specially serious heavy metals, Cr, Cd, Pb, will enable us to introduce specific abatement facilities for each type of manufacturing sectors to remediate the

- contamination.
2. Predicting the effect of economic growth on increasing the load of pollution in long-term, allow us to introduce and analyze an optimal policy to reduce the water pollution in the basin.
  3. Studying the contribution of pollution loads among zones would determine the adequate sharing of mitigation cost and introduce various economic instruments regarding each district.
  4. Determine the necessity of risk assessment of heavy metals on environment and human health in particular.

## References

C.J. Van Leeuwen and J.L.M. Hermens (1995): **Risk Assessment of Chemicals: An Introduction**, Kluwer Academic Publishers, Dordrecht, The Netherlands, 374p.

Edward Kuiper (1971): **Water Resources project economics**, Butterworth & Co Ltd., London,447p.

Falouh J. (2000): **Water Resources in Barada and Awaj Basins**, Ministry of Irrigation documents, Damascus (Arabic).

Higano Yoshiro, Hirose F. (2000): **A Simulation Analysis to Reduce Contamination from the Catchment Area of Lake Kasumigaura**, Studies on regional science Vol.30, No. 1, pp. 47-63.

Higano Yoshiro, Takayuki Sawada (1995): **The Dynamic Optimal Policy to Improve the Water Quality in Kasumigaura Lake**, Studies on regional science Vol.26, No. 1, pp. 75-86.

Ikkatai, Seiji (1998): "The latest State of The Water Quality Management Policy". **Journal of Resources and Environment**, Vol.34, No. 3, pp 5-10.

James A. (1978): **Mathematical Models in Water Pollution Control**, Chichester, Wiley, 420p.

JICA (1996): **Developing Water Supply System for Damascus City: Phase I**, Ministry of Environment documents.

Ministry of Environment (1996): **Syrian Standard for Wastewater Discharged to Sewerage System**, Ministry of Environment Document, Damascus (Arabic).

Ministry of Environment (1995): **Heavy Metal Analysis for Vegetable**, Ministry of Environment Document, Damascus (Arabic).

Ministry of Environment (2001): **National Overview of Chemicals Pollution and Safety**, Ministry of Environment Document, Damascus (Arabic).

Ministry of Housing (2000): **Adra Treatment Plant**, the Ministry of Housing documents, Damascus.

Ministry of Industry and Mineral Resources (2000): **Statistics of the Economic Activities**, Documents of Ministry of industry, Damascus (Arabic).

MLA ( 1996): **Samples results from the labs of municipalities**, Ministry of local administration(Arabic).

Ministry of Supply(2000): **Specific Economic Data**, Documents of Ministry of Supply, Damascus(Arabic).

Shawaf S. (2000): **The Contamination of Barada River**, Ministry of Irrigation documents, Damascus (Arabic).

Statistic Institute(2000): **Statistic Handbook for Syria**, Damascus.

WHO(1993): **Assessment Of Sources Of Air, Water, And Land Pollution, Environmental Technology Series**, Geneva

William J. Baumol, Wallace E. Oates (1979): **Economics, Environmental Policy, and The Quality of Life**, Prentice-Hall, Inc., Englewood Cliffs, USA.

World Bank (WB), United Nation Environmental Program (UNEP), and Ministry of Environment (1997): **PEAP for Barada Basin**, Ministry of Environment documents, Damascus.

WB(1994): **The Industrial Pollution Projection System IPPS**, World Bank.

World Bank Group(1998): **Pollution Prevention and Abatement Handbook**, World Bank.

Valery L. Makarov, Mark J. Levin, Alexander M. Rubinov(1995): **Mathematical economic theory**:Elsevier, North-Holland, Amsterdam, 610p.

Vincent T. Covello, Miley W. Merkhofer (1993): **Risk assessment methods : approaches for assessing health and environmental risks**, Plenum Press, New York, 267p.

## **Role of information technology as a contributor of economic growth**

Jorma Pietala & Kristiina Korhonen

Economic Geography, Helsinki School of Economics, Finland  
[pietala@hkkk.fi](mailto:pietala@hkkk.fi), [kristiina.korhonen@hkkk.fi](mailto:kristiina.korhonen@hkkk.fi)

This paper is interested in the role of information and communication technologies (ICTs) contributing economic growth. Economic growth is created through population and productivity growth. As the population growth is more like negative in post-industrial economies, the economic growth has to be based on productivity through improvements in such fields as education and technologies. In this context, rapid technological development of the ICT industries is one of the most evident cases. ICT industries have doubled from USD 1.3 trillion in 1993 to over USD 2.4 trillion in 2002. Despite the present economic slowdown, ICT sector is expected to continue its growth worldwide.

ICT is not just an industrial sector of its own, but a modernising force in society, having impacts on overall productivity and output per capita. For example, firm-level studies on productivity growth (egBrynjolfsson & Hitt 2002) have shown that computerisation is a part of larger technological and organisational change, which have positive impact on firm performance over time, as the impacts are stronger in long-term than short-term. These results suggest that computerisation is not only investment in physical resources, ie the computers and other equipment, but requires complementary investment in organisational resources of the firm. Thus, personnel training and development of new organisational processes becomes essential.

Turning attention to national level, analogical phenomenon is the suggested positive impact of ICT investment on economic growth. Adapting Brynjolfsson and Hitt's (2002) idea, the ICT investment

alone is not enough to create long-term economic growth, but complementary investment in education and infrastructure is needed. Studies have shown undoubted correlation between ICT investment and economic growth in the case of United States (eg Oliner & Sichel 2000). Studies explain that ICT-investments are boosting economy in three ways: through increased capital deepening, increased quality of labour, and technological and managerial advances, which allow greater amount of output to be had for a given set of inputs. This is called multi-factor productivity.

However, studies on other economies (eg Pohjola 2002) have not found any significant correlation, or the correlation is confined only to computer industry (eg Gordon 2000). Pohjola (2002) explains this controversy first by pointing out that the United States is the largest investor in ICT in the world, while the level of ICT investment in other economies remains somewhat marginal. On the other hand, he reminds that in other economies than United States, the level of complementary investment in education and skills is not high enough to utilise the benefits from ICT investment. These arguments support our idea on adopting firm-level results to national level.

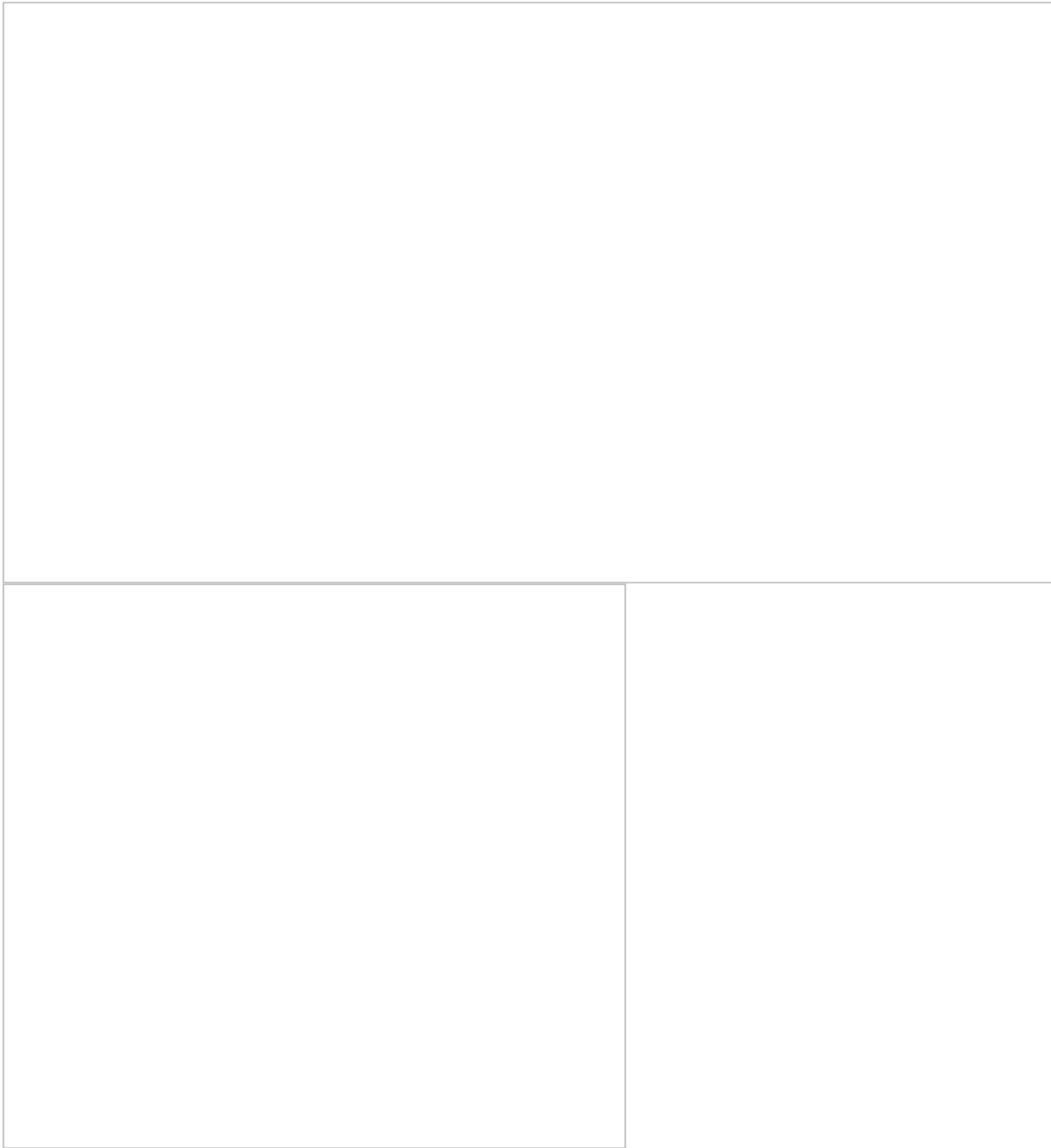
In addition to ICT investment and complementary investment, the firm-level studies let us also expect that the positive impacts on economic growth are visible only in the long-term. As the ICT investment is rather recent phenomenon, it may be possible that economic impacts are not yet visible in the leading ICT countries, with an exception of the United States. For example, the share of ICT industry on GDP in the United States has increased from 7.1. % in 1992 to 8.1 % in 2001, while it is still in the lower level in the EU where it has increased from 5.1 % in 1992 to 7.0 % in 2001. Thus, in the present study, the correlation between ICT investment and economic growth is studied with special reference to some leading ICT countries. Moreover, the empirical studies have shown that rapid ICT development has become possible in those countries, which have undergone liberalisation process and break up of the national telecom monopolies. Thus, in the current paper, the attention is turned to case countries in which the early liberalisation process has allowed high ICT investment, high teledensity, and suggested positive impact on economic growth.

## **1 The Dimensions of ICT -Related Growth**

The starting point for analysing ICT –related growth in national level is to categorise countries according to their advancement in ICT sector. This categorisation is based on the linear combinations of single variables on telecommunication and gross domestic product (GDP) development. The data consists of country specific structural data on all the countries of the world, as provided by Statistics Finland. Selected variables include general economic figures as well as figures indicating the advancement of ICT, such as number of fixed phone lines, number of mobile connections, share of mobiles of all connections, number of personal computers, number of internet hosts and number of internet users. Totally 241 countries are included to the analysis.

Unfortunately, some very important variables, such as external debt, research and development (R&D) expenditure and savings ratio, are not available in Statistics Finland worldwide comparisons and thus, are excluded from the analysis. Although the data covers the period 1997-2001, the most recent figures are not available in all cases. In the treatment of particular variables, such as export figures, this is problematic because the year 1999, which is the most recent available export figure, represents the rather vulnerable time in the aftermath of the Asian crisis and thus, is not the best possible year for the analysis. The data reduction is made by principal component analysis and the interpretation is based on Varimax rotated model with Kaiser normalisation.

**Tables 1-2.** Total variance explained and rotated component matrix



The analysis produces four distinct dimensions, which explain 77 % of the total variance. The components are interpreted as follows:

1. Established ICT-countries
2. ICT-driven export-oriented countries
3. Countries with fast growth of GDP and expenditures
4. Growth boosted by foreign direct investment (FDI) and mobile communications

The national scores of all four principal components obtained by regression method are described in following series of maps (Figures 1-4). The first principal component emphasises high level of economic development together with large number of fixed phone lines, mobile connections, PCs, internet hosts and internet users. Thus, established ICT countries refer to countries with high ICT density, such as most Northern American or Western European countries, including Finland.

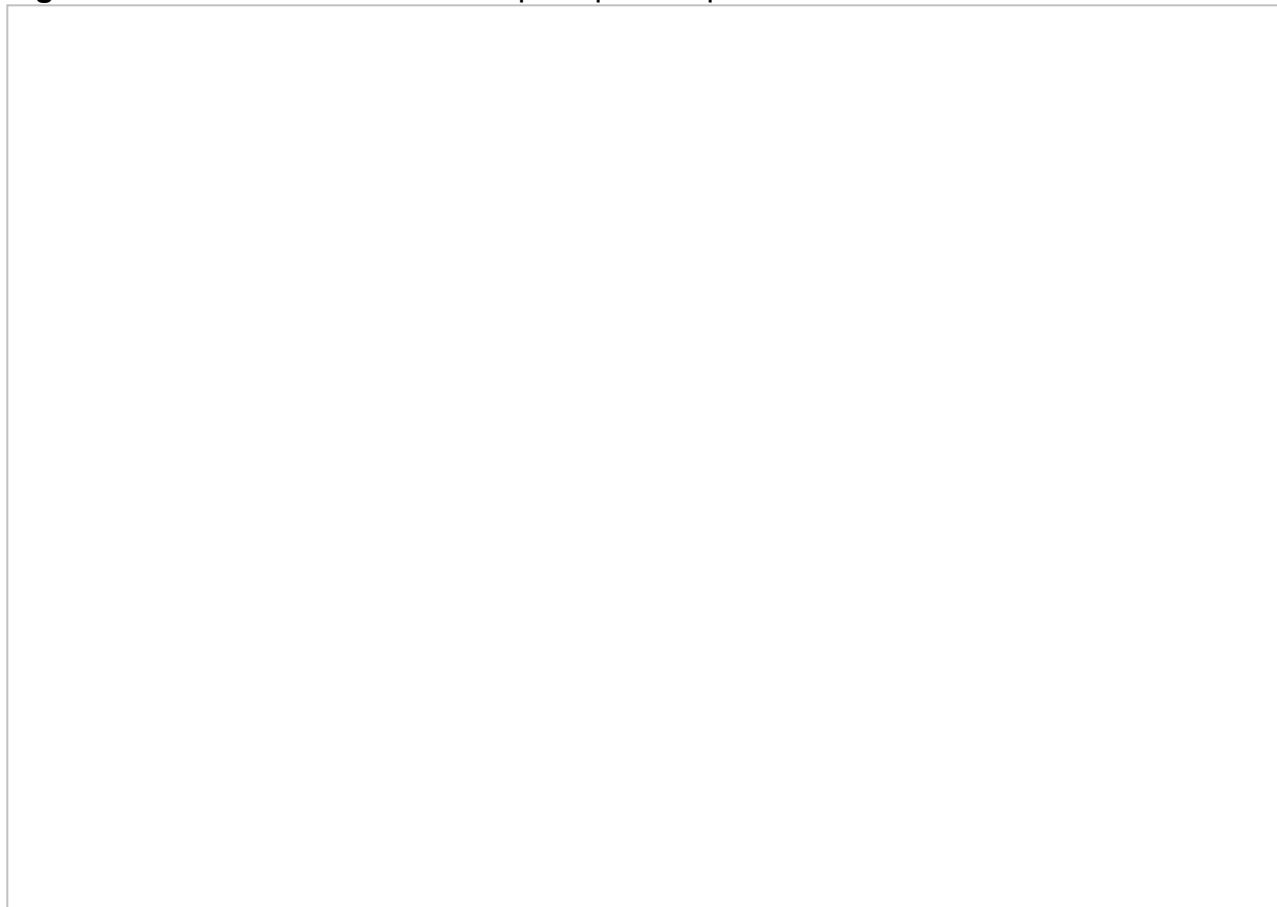


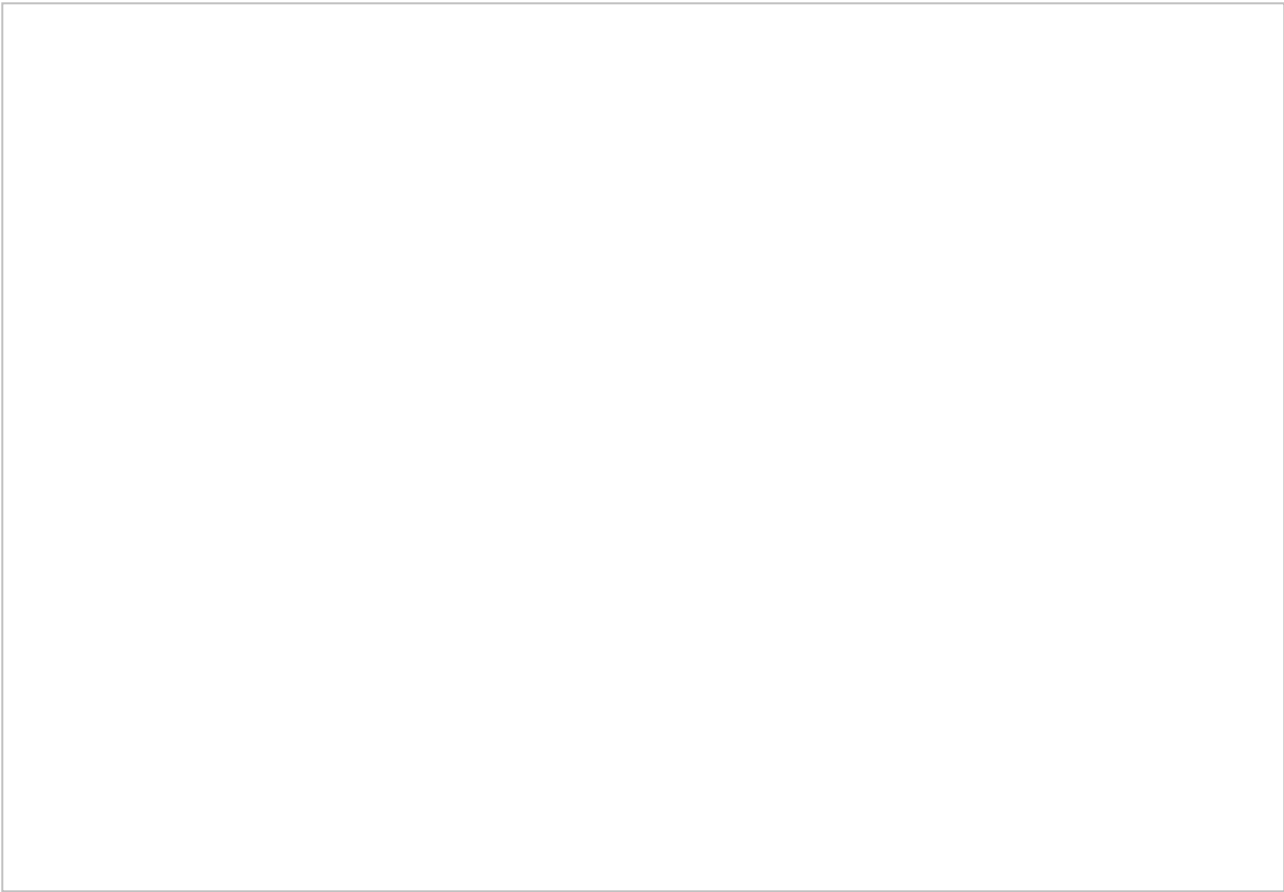
In the second principal component only the loadings of share of exports and income of telecommunication on GDP are emphasised: South Korea is a case in point, as its ICT sector covers 28 % of total exports. In addition, South Korean ICT exports have continued to increase despite the Asian crisis in the end of 1990s and recent worldwide economic downturn. Kim (2002) suggests that the contribution of ICT investments to economic growth after economic crisis could be even greater than the figures based on conventional growth accounting. Strong structural reform after crisis might also have helped ICT investments to have a substantial impact on firm performance.

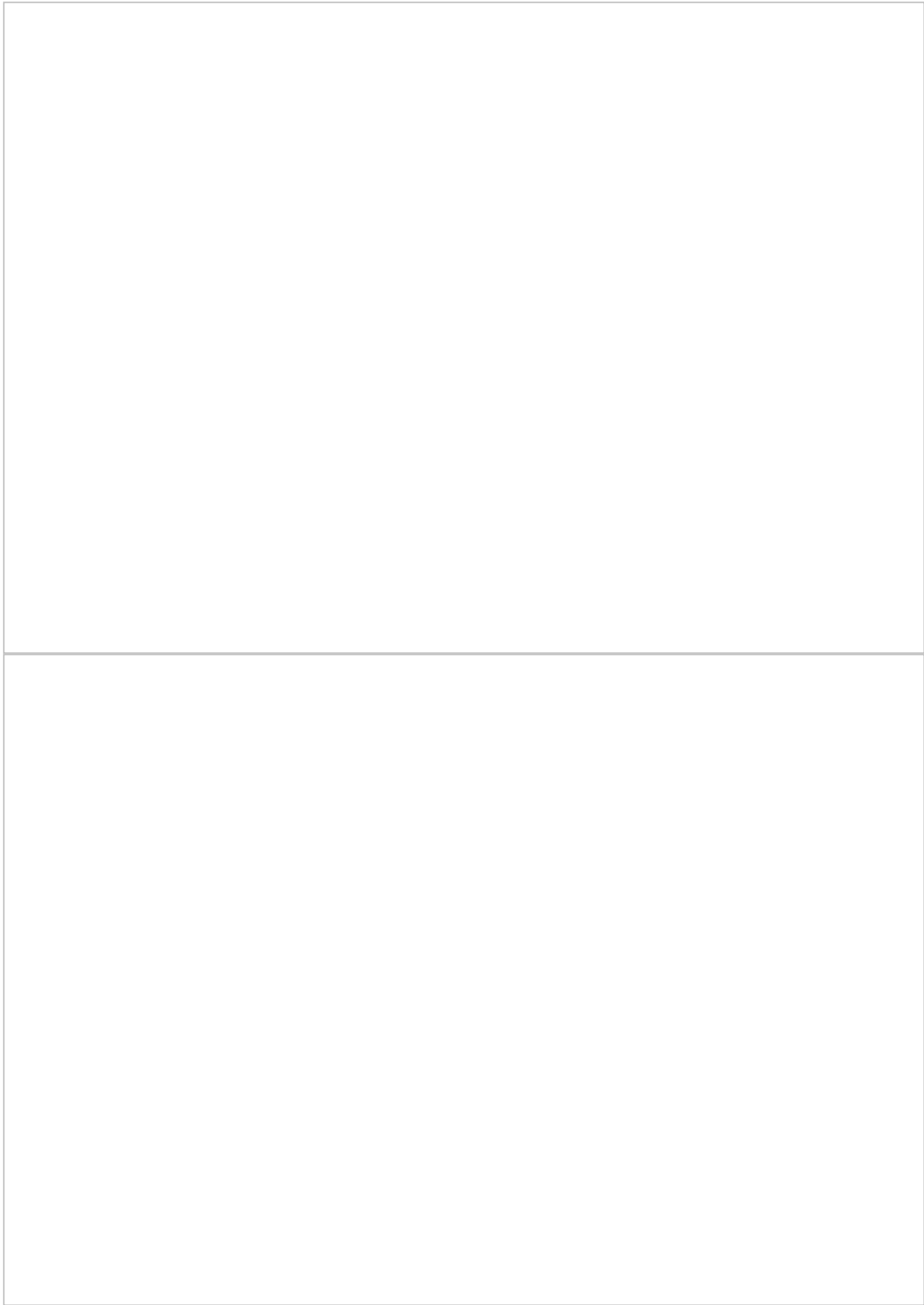
In third principal component, fast growth of expenditures and GDP are emphasised. These variables become important in countries such as China, where infrastructure is still in the initial stage. However, China's real GDP is about three times bigger than that of neighbouring South Korea or Taiwan, and it is the world's fastest growing ICT nation. Thus, the Chinese government promotes the ICT business as a growth engine, attracting keen attention from foreign investors. China is also expected to modernise through ICT investment. (Witsa 2002)

Finally, in the fourth principal component, the loadings of rapid economic growth together with large FDI and share of mobile connections become influential. Good example is provided by Ireland, whose information economy expanded during the 1990s, with significant employment growth in software, financial services and telecommunication services. This resurgence was closely associated with FDI. Ireland's peripheral location was overcome by provided the necessary infrastructure and human resources by means of extensive use of ICTs (eg Grimes 2003).

**Figures 1-4.** The national scores of principal components.







**2 Economic Growth Explained by Selected Variables**

Economic growth is measured by the average annual growth of GDP. Efforts are made to explain it by single variables, as the multivariate regression analysis is not possible due to the overlapping

predictors or missing values in statistics. The results of these efforts are shown in Tables 3-5. It shows up that there are only two significant predictors for GDP growth: mean annual growth of expenditures during the period 1980-1988 and external debt in 1999, as shown in Table 3. However, this is the case only in established ICT countries. Even in these countries such indicators, as the savings ratio and R&D inputs are not significant predictors.

**Tables 3.** Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
<u>Model</u>				
<u>CONTCODE</u>				
<u>= 5)</u>				
1	,602	,362	,316	1,248
2	,772	,596	,533	1,031

a Predictors: (Constant), EXPEN0\_8

b Predictors: (Constant), EXPEN0\_8, DEBT99

**Table 4.** Analysis of variance between groups

Model		Sum of Squares	df	Mean Square	FSig.
<u>1</u>					
Regression	12,357	1	12,357	7,939,014	
Residual	21,792	14	1,557		
Total	34,149	15			
<u>2</u>					
Regression	20,337	2	10,169	9,571,003	
Residual	13,812	13	1,062		
Total	34,149	15			

a Predictors: (Constant), EXPEN0\_8

b Predictors: (Constant), EXPEN0\_8, DEBT99

c Dependent Variable: GDPX0\_0

d Selecting only cases for which CONTCODE = 5

**Table 5.** Coefficients

Model	Unstandardised Coefficients		Standardised Coefficients		tSig.
	B	Std. Error	Beta		
<hr/>					
1					
(Constant)	1,391	,477		2,917,011	
EXPEN0_8	,722	,256	,602	2,818,014	
<hr/>					
2					
(Constant)	1,329	,394		3,369,005	
EXPEN0_8	,902	,222	,751	4,068,001	
DEBT99	-7,103E-02	,026	-,506	-2,741,017	

a Dependent Variable: GDPX0\_0

b Selecting only cases for which CONTCODE = 5

An important observation is made concerning the models separated by the continents. For example, in the case of Latin America, the growth can be explained almost on the same level of significance (51 %), but only with one predictor, the mean annual growth of expenditures. Consequently, in Asia, the same variable is valid, but the significance level goes down to 20 %.

A test, which uses principal component scores as predictors, is also made. The ICT related variables and FDI explain well the level and growth rate of GDP. However, the presence of multicollinear variables makes the model open to questions.

### 3 Case Countries

This paper compares the role of ICTs in three economies. The selected case economies are Finland, South Korea (hereafter Korea) and Chile, which are all advanced countries in respect of ICT, representing different continents. In all of these three economies, government has promoted ICT industry growth through infrastructure and education inputs in order to boost the national economy. However, the outcomes have turned to be somewhat different. The aim of the study is to discuss the similarities and differences among the three economies in terms of ICT industry growth, economic growth in general, and shift towards information society.

#### 3.1 Finland – Information Society.

Finland is generally considered as information society where the citizens, firms and public administration have widely adopted the use of new ICT. The rapid development of ICT sector is due to the early liberalisation and break up of the national telecom monopolies. Indeed, Nordic countries were among the first countries in the world to introduce competition into telecommunications since the 1980s. Also in Finland, the operations of the national monopoly, the Post and Telegraph Office, were separated from the national budget and it was turned into a 100% state-owned limited liability company in 1994. Later, the company was renamed as Sonera and it became quoted on the Helsinki and New York Stock Exchange.

Competition in long-distance calls was allowed in 1994 and a new carrier took immediately half of the market resulting in price drops of more than 50 %. Local companies started to form alliances to compete with the former government national carrier Sonera. In mobile connections, GSM carrier [Radiolinja](#) started its operations in 1991 being the first GSM operator in the world. This early development has been explained by gradually increased R&D expenditures, which has now exceeded 3 % of GDP, as well as by Finnish government who has promoted especially innovative SMEs by creating various financial instruments. Basically, Finns have also regarded development and innovations positively.

For Finnish economy, the role of manufactured goods typical of the information society has become increasingly important, as the share of those products of foreign trade has been growing rapidly. Nowadays (2001), high tech exports account for 28 % of Finnish exports, even more than the traditional forest (27 %) and metal exports (27 %). In addition, the value of information technology exports has nearly tripled in the 1996-2000 period, which means annual growth with an average of 30 %. Over the same period, Finland's total exports have grown only by 12 % per year, on average. The most important, and internationally most successful, part of Finnish ICT sector is telecommunications equipment. Other successful products are electric motors, transformers, optical cables, silicon wafers and sensors, electroluminescence displays, and weather and airport instrumentation.

In general, deepening integration with other Western European countries will dominate the Finnish economic development over the next several years, as Finland was one of the 11 countries joining the euro monetary system (EMU) on 1999. At the moment, economic growth is held back by the global slowdown, but prospects in ICT sector look encouraging on a longer term. ICT exports continue to promote the economic growth during the present slowdown.

### **3.2 Korea – One of the Best Telecommunication Infrastructures in the WWorld.**

Korea has become one of the best telecommunication infrastructures in the world, where half of the population are active internet and mobile phone users. Korean government has been proactive to establish a knowledge-based society, as it has deregulated telecommunication industry in order to help country's internet and wireless market. In addition, the use of telephone and broadband network services, high-speed cable modems, and DSL services is relatively cheap even in Asian standards.

Korea Telecom retained a monopoly over call services until 1992. Korean government opened up competition by awarding a license to another local call service provider. In addition, it awarded licenses to two more long-distance and international call service providers. There are also three wireless telecommunications carriers. Along the Asian crisis, in 1998, Korean government continued deregulation in order to attract foreign investment and to speed up the privatisation of Korea Telecom. Therefore, it has issued more than 30 licenses for emerging telecommunications services, such as phone call reselling, internet telephony and in-house phoning. Recently, the market has shifted from voice to data. There are seven competitors offering high-bandwidth internet services. The demand for broadband internet services has reached in 2001 almost 8 million subscribers, recording the highest density in the world (Kim 2002).

ICT sector has become crucial for Korean economy, as the share of ICT industry accounts to 28 % of total exports and 13 % of GDP. In 2002, ICT exports grew 20 % (to USD 46 billion) over 2001 and ICT trade surplus hit USD 15 billion. Earlier, Korea has been known especially from its semiconductor production and exports, which accounted for 62 % of total exports in the period 1993-1997, but recently, ICT exports have diversified and thus, the share of semiconductors has decreased and new products, such as mobile phone handsets increased.

In general, Korean economy was harmed by the Asian financial crisis of 1997-99, which exposed certain longstanding weaknesses in Korea's development model, including high debt/equity ratios, massive foreign borrowing and an undisciplined financial sector. After the crisis, Korean economy

recovered to plus 10 % in 1999 and 9 % in 2000, but fell back to 3.3 % in 2001 due to the slowing global economy, falling exports, and the perception that much-needed corporate and financial reforms have stalled. However, the ICT sector is still holding on, and especially the export of telecommunication gadgets is continuously increasing.

### **3.3 Chile - the Most Advanced ICT Country in Latin America.**

Chile has the most advanced telecommunications sector in Latin America. It was the first country in the region to initiate privatisation and liberalisation, and by 1989 all state-owned telecommunications companies were sold, including the CTC (Compañía de Telecomunicaciones de Chile, a local telephone service provider) and Entel (long distance service provider). In Latin American context, Chile is now fully liberalised market, while most of the nations in the region are just initiating privatisation and opening up to competition. In Chile, liberalisation has resulted in various positive effects: telephone penetration was tripled in the decade after privatisation, prices dropped by 40-50 %, and traffic increased by 40 % due to the opening up the long distance market. Today, there are eight competitive carriers. Despite of these various improvements, there is still great potential for growth. During the last decade, average growth rate for ICT sector has been 20 % per year.

Mobile telephone services have led the ICT growth. Chile is 100 % digital and mobile penetration has surpassed fixed phones lines. However, also the fixed line services have improved since privatisation and deregulation of the industry. Free competition has resulted in heavy investment in the telecommunications infrastructure. In addition, Chile has the highest credit card, PC and internet penetration in Latin America and thus, is well prepared to support e-business. Moreover, the country of 15 million people has become a testing ground for many international corporations before they enter the rest of Latin America. Thus, over USD 1 billion has been invested in Chilean ICT sector.

Chilean government has been technologically advanced in its aims to let all Chileans to enjoy the ICT growth. For example, Chile has used wireless services in innovative ways to link residents in isolated rural areas, where the cost of laying a traditional wire line network has precluded them from being a part of a country's national network. Special efforts have also directed to schools and thus, 90 % of student population is connected to internet. Government has also introduced electronic signatures and invoicing, as well as internet tax declarations.

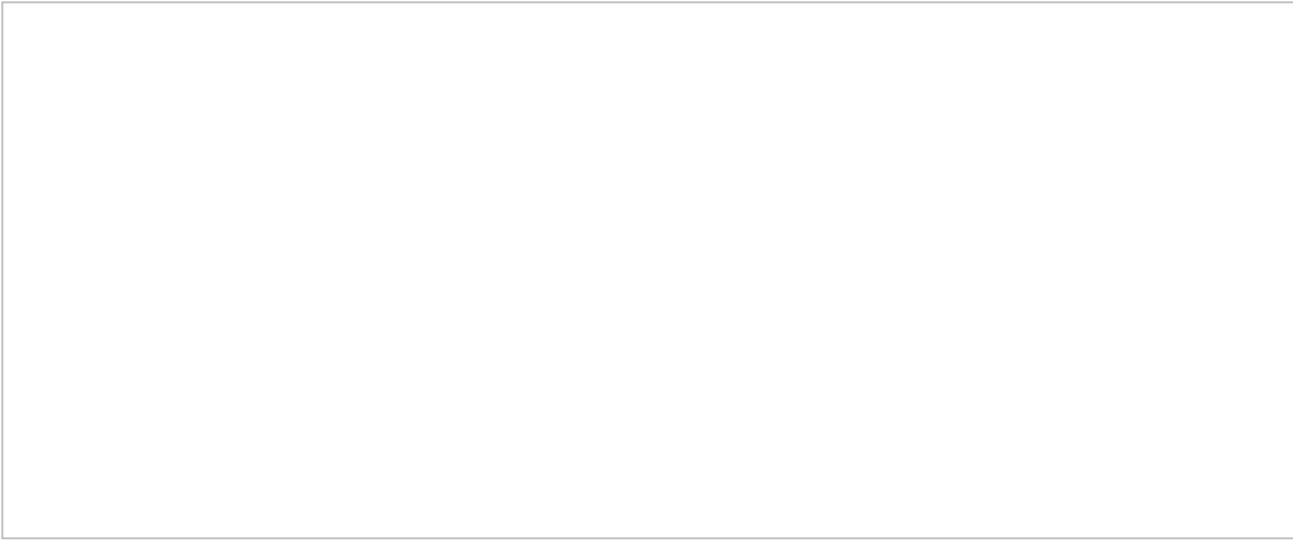
In general, Chilean economy was harmed by the worldwide recession in 1999 when it experienced negative economic growth for the first time in more than 15 years. However, by the end of 1999, exports and economic activity had begun to recover, and growth rebounded to 5.4 % in 2000. Meanwhile, Chile and the United States are conducting negotiations for a free trade agreement. In Chilean exports, the role of telecommunications is still marginal. However, due to the absence of trade barriers, the telecommunications market will continue to expand. This expansion will occur most likely through the establishing of alliances with local and multinational companies to provide telecommunications services throughout Latin America.

## **4 Evidence on ICT Led Economic Growth?**

The long-term development of gross national incomes (GNI) per capita in three case countries is illustrated in Figure 5. In the beginning of the period (1980-2000), Finland represented an economic level four times higher than in Korea and Chile. Along the period, this difference has remained same. Differently, Korea has managed to double its GNI in relation to Chile due to the rapid economic growth since the mid-1980s. In the beginning of the 1990s, there was severe depression in Finland and thus,

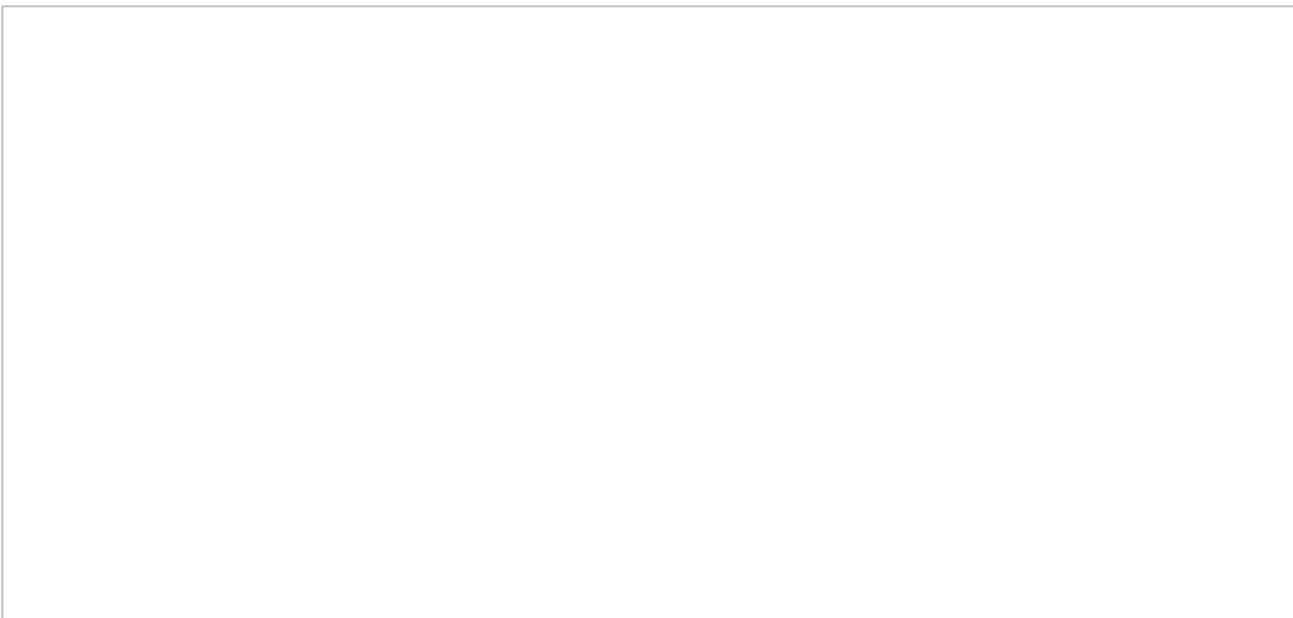
differences between the case countries decreased temporarily. Correspondingly, Korea and Chile were harmed by the Asian crisis in the end of the 1990s, while Finnish economy improved.

**Figure 5.** The development of the GNI per capita in 1980 - 2000 (USD)



In Figure 6, the development of major ICT –related variables during the study period of 1997-2001 are illustrated. Especially the comparison of case countries in terms of mobile phones is interesting. In the case of Finland, mobile phone penetration is already so high that the curve is S-shaped referring to slowdown in growth. Thus, the mobile phone market in Finland focuses almost solely on more sophisticated new models. In Korea, the increase of new mobile connections has been even faster than in Finland, as it was started later, but also there the growth has already slowed down. This is different from Chile, where the mobile phone market is in rapid growth phase.

**Figure 6.** The development of key indicators during the research period.



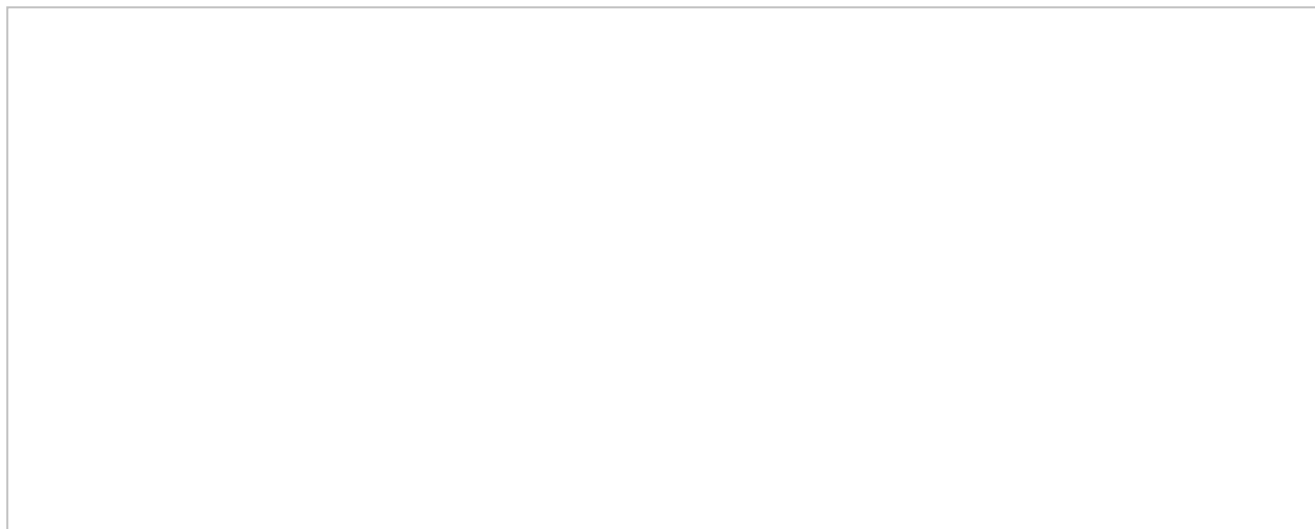


In all case countries, including Chile, the mobile penetration has already surpassed fixed phones lines. However, both in Korea and Chile, the number of fixed phones is still increasing, although slowly. In Finland, the number of fixed phones has been decreasing gradually for some time now. The number of PCs is increasing gradually in all three countries, and seems to continue its growth without any signs of maturation.

What comes to share of ITCs on GDP, it is rather low in all case countries. GDP curves show the significant annual fluctuations due to the Asian crisis in Korea and Chile, and recent worldwide economic downturn in all case countries. These fluctuations make it difficult to find evidence on correlation between ICT investment and economic growth.

Finally, in Figure 7, the principal component scores of case countries are compared. The comparison shows that in the first principal component, the established ITC countries, Finland is evidently the strongest. Differently, Korea and Chile are rather strong in terms of ICT –led exports. However, interpretation of the principal component scores becomes problematic in terms of correlation between exports and ICT incomes on GDP, in the case of Korea and Chile. This is because there is no obvious statistical evidence on reasons and consequences. Moreover, export figures consists of data on year 1999 only. The year 1999 represents the economic slowdown especially in Asia, but also in Latin America. Even in Finland, the exports in 1999 were significantly weaker than normally. Moreover, great differences in general economic level between the countries, may explain the differences in the principal component scores.

**Figure 7.** The comparison of principal component scores



The third principal component, in which the loadings are directed to fast growth of GDP and expenditures, shows that the long-term average growth in GDP has been significantly faster in Korea and Chile compared to Finland. Finally, in the case of fourth principal component, it becomes obvious that FDI has promoted economic growth in all countries, but the impact is most visible in the case of Chile, where the GDP growth is strongly related to ICT sector, similar to Ireland, for example.

## 5 Conclusion

Along the analysis, it has become obvious that finding evidence on ICT –led growth is somewhat challenging task. On the one hand, the lack of comparable and accurate data concerning all case countries makes it difficult to make any detailed comparisons of case countries. On the other hand, if

the ICT investment has the impact on economic growth only over long periods, it becomes difficult to analyse the variables due to the significant annual or cyclical fluctuations or structural differences between countries.

As seen in Figure 6, the growth rate of GDP is very oscillating in short term and even the direction of change can be unpredictable. Furthermore, the impact of ICT investment may be delayed for many reasons and the indicators of a specific year may be misleading as well. Thus, it seems obvious, that we should use long-term predictors on growth rates to explain the corresponding change in GDP. Even in that case, there are difficulties in estimating when the time period of increased productivity has started.

According to literature, investment in physical ICT resources is not enough but complementary investment in organisational resources is needed. It seems that these actions together have impacts on business effectiveness and performance and thus, also on national economic growth. In all of case economies of the present study, government has promoted ICT industry growth through infrastructure and education inputs in order to boost the national economy. The levels of development are, however, different, depending on timing of deregulation. Thus, Finland, who was among the early starters, comes up to concept of information society. Correspondingly, Korea is ambitiously building knowledge-based society. In Chile, the role and development of ICT industry is more likely to depend on FDI.

The development of export sector has arisen as an outstanding feature of the economic success of all case countries of the present study. With regards to ICT exports, in Finland and Korea they are expected to form one third of the total exports both in the immediate future, as they already account for 28 %. Thus, the ICT sector has become crucial for both economies relatively fast. Differently, Chilean exports are still highly characterised by strong resource intensiveness and are suggested to remain as such for foreseeable future.

According to present analysis, only some preliminary suggestions on ICT investment's positive impact on economic growth can be made. The emergence and rapid growth of ICT industry has certainly helped the case countries to overcome the economic downturns. This refers to Asian crisis in the cases of Korea and Chile, and to present worldwide downturn in the case of all three countries. Fictitious hypothesis on the absence of ITC industry may be absurd as such, but illustrates the balancing and extremely important effect of the ICT sector for these export dependent countries struggling in the cyclical world economy.

## References

Brynjolfsson, Erik & Lorin M. Hitt (2000) Beyond computation: information technology, organisational transformation and business performance, *Journal of Economic Perspectives*, Vol. 14, No. 4, pp. 23-48.

Brynjolfsson, Erik & Lorin M. Hitt (2002) Computing productivity: firm-level evidence, *MIT Working paper*, No. 4210-01, Massachusetts Institute of Technology.

Gordon, Robert (2000) Does the 'New Economy' Measure Up to the Great Inventions of the Past? *Journal of Economic Perspectives*, Vol. 14, No. 4, pp. 49-74.

Grimes, Seamus (2003) Ireland's emerging information economy: recent trends and future prospects, *Regional Studies*, Vol 37, no 1, pp. 3-14.

Kim, Jong-Il (2002) *Information Technology and Firm Performance in Korea*. Paper presented in 13th Annual East Asian Seminar on Economics, June 20 -22, 2002, Melbourne, Australia

Oliner, S. & D. Sichel (2000) The resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives*, Vol. 14, No. 4, pp. 3-22.

Statistics Finland (2003) World in Figures, 28 Excel tables of country-specific structural data (248 themes) on all the countries (241 countries) of the world, [www.tilastokeskus.fi](http://www.tilastokeskus.fi)

Pohjola, Matti (2002) The new economy in growth and development, *Oxford review of economic policy*, Vol 18, No 3, pp. 380-396.

Witsa (2002) *Digital planet 2002: the global information economy*, World information technology and services alliance.

## Appendix: Variables and their explanations

Variables	Explanation
1. Maa	Country
2. Country	Country
3. GDP98	GDP 1998 (USD Million)
4. gdpcap00	GDP per capita 2000
5. gdp00	GDP 2000 (USD Million)
6. gdp0_0	GDP average annual growth rate 1990-2000
7. balance0	Current account 2000 (percentage of GDP)
8. exp99gdp	Export of good and services 1999 (percentage of GDP)
9. cont	Continent
10. contcode	Code of continent
11. lines97	Fixed phone lines 1997
12. lines98	Fixed phone lines 1998
13. lines99	Fixed phone lines 1999
14. lines20	Fixed phone lines 2000
15. lines01	Fixed phone lines 2001
16. lines97p	Fixed phone lines 1997 per 100 persons
17. lines98p	Fixed phone lines 1998 per 100 persons
18. lines99p	Fixed phone lines 1999 per 100 persons
19. lines20p	Fixed phone lines 2000 per 100 persons
20. lines01p	Fixed phone lines 2001 per 100 persons
21. mob97	Mobile connections 1997
22. mob98	Mobile connections 1998
23. mob99	Mobile connections 1999
24. mob20	Mobile connections 1997
25. mob01	Mobile connections 2001
26. mob97p	Mobile phone connections 1997 per 100 persons
27. mob98p	Mobile phone connections 1998 per 100 persons

28. mob99p	Mobile phone connections 1999 per 100 persons
29. mob20p	Mobile phone connections 2000 per 100 persons
30. mob01p	Mobile phone connections 2001 per 100 persons
31. mob98all	Percentage of mobiles of all connections 1998
32. mob99all	Percentage of mobiles of all connections 1999
33. mob20all	Percentage of mobiles of all connections 2000
34. mob01all	Percentage of mobiles of all connections 2001
35. pc10097	Personal computers per 100 persons 1997
36. pc10098	Personal computers per 100 persons 1998
37. pc10099	Personal computers per 100 persons 1999
38. pc10020	Personal computers per 100 persons 2000
39. pc10001	Personal computers per 100 persons 2001
40. pci99	Internet hosts 1999
41. pci00	Internet hosts 2000
42. pci01	Internet hosts 2001
43. pci02	Internet hosts 2002
44. pci10099	Internet hosts 1999 per 1000 persons
45. pci10000	Internet hosts 2000 per 1000 persons
46. pci10001	Internet hosts 2001 per 1000 persons
47. intuse01	Internet users 2001
48. iu011000	Internet users 2001 per 1000 persons
49. itinc97	Income of telecommunications 1997 (percentage of GDP)
50. itinc99	Income of telecommunications 1999 (percentage of GDP)
51. savrat00	Household savings ratio 2000 (percentage of GDP)
52. expen0_8	Mean annual growth of expenditures 1990-1998
53. debt99	External debt of GNI 1999
54. fdi99	Percentage of foreign direct investments of GDP 1999
55. resdev98	Percentage of research and development inputs of GDP
56. fac1_1 countries	Principal component scores for ICT-intensive
57. fac2_1 countries	Principal component scores for export oriented
58. fac3_1 countries	Principal component scores for fast growing
59. fac4_1 expenditures	Principal component scores for growing

## Competitividad global y reestructuración económica y laboral en Guadalajara, 1987-2000.

Salvador Carrillo Regalado  
 Departamento de Estudios Regionales-INESER, Universidad de Guadalajara  
[mmch@prodigy.net.mx](mailto:mmch@prodigy.net.mx)

El presente trabajo expone los cambios dados en la estructura productiva y laboral de la zona metropolitana de Guadalajara (ZMG)<sup>[1]</sup>, explicados de acuerdo con su nuevo rol en el nuevo modelo de desarrollo que responde a una intensa competitividad global. Además, a partir de esto, se evalúa la especialidad de su estructura

económica, los ámbitos territoriales de su crecimiento (regionales, nacionales o globales) y el efecto que esto ha significado en las ocupaciones. La hipótesis es que la competitividad global y la reestructuración han significado para Guadalajara un desplazamiento de la tradicional funcionalidad económico regional hacia una base de crecimiento más orientada a los mercados nacionales e internacionales, a la vez que ha provocado sensibles impactos en la estructura ocupacional de la mano de obra.

En México, el centro urbano más integrado al bloque de países de América del Norte y que en general se muestra económicamente más globalizado es la ciudad de México, donde se establece la mitad de las oficinas matrices de las 500 mayores empresas (Rodríguez, 1999; Parnreiter, 2002: 385-389) cuya ventaja deriva de la centralización económica y política sobre el resto de los centros urbanos, y que ante el Tratado de Libre Comercio, sólo reforzó sus funciones de gestión y coordinación internacional. Pero en el ámbito interno regional otras ciudades están siendo integradas, tales son las dos ciudades que le siguen en tamaño (Guadalajara y Monterrey), las principales ciudades fronterizas y algunas ciudades de mediano tamaño en extensas regiones del norte y del centro del país; lo cual sucede a medida que han fluido las inversiones extranjeras directas según estrategias de localización de las grandes firmas transnacionales o al poner en práctica el asociarse con grandes empresas nacionales. Una implicación generalizada en todas las grandes ciudades que son incorporadas a la actividad globalizadora es la generación, en mayor o menor grado, de actividades terciarias en el subsector de servicios productivos, en los cuales también los capitales internacionales están muy interesados, tales como: servicios financieros, de seguros, inmobiliarios, de consultoría, legales, aduanales o de comercio exterior, diseño, marketing, relaciones públicas, información y administración de sistemas informáticos, etc. (Borja y Castells, 1995) Situación que se comprueba más adelante en el caso de Guadalajara.

## 1. Antecedentes de la especialización económica regional de Guadalajara

Durante el periodo industrializador sustitutivo de importaciones, el crecimiento económico y especialización de la ZMG dependió primordialmente del mercado regional del occidente de México y en menor medida del nacional. En general, las ciudades pueden clasificarse según su especialización y alcance territorial de sus mercados para sus actividades básicas o predominantes, aunque vinculadas entre sí en una jerarquización regional, nacional e internacional (Pozos, 1996: 46) Guadalajara, optó durante el periodo de industrialización sustitutiva, por una especialización industrial destinada a satisfacer las necesidades de su amplia y urbanizada región de influencia en el Occidente y Pacífico Norte, extendiéndose en menor grado al

ámbito nacional. Esta ciudad se abocó, en primer orden, a la especialización de bienes básicos <sup>[2]</sup>, sustentada principalmente en innumerables empresas de pequeño y mediano tamaño de bajos requerimientos tecnológicos, de baja relación K/L y fincada en una abundante demanda de mano de obra, la cual no requería un alto nivel de calificación y formalidad (Ibid: p 64 y 76) En términos generales, Guadalajara continúa hasta la segunda parte de los años setenta una doble vocación en su especialización hacia los mercados regional y nacional: industrial de bienes básicos y comercial, conformando una planta productiva caracterizada por un predominio de pequeñas empresas y una demanda de mano de obra que fue satisfecha por los fuertes flujos de población inmigrante y de escasa calificación (Pozos, 1996: 75; Winnie, 1986: 134-146; Arias, 1985: 77-121) derivando además en la conformación de un dinámico e importante sector económico informal (Escobar, 1986: 127-192; Roberts, 1989: 41-59)

Incluso a finales de los años ochenta, después de la crisis y las recesiones económicas subsiguientes, Guadalajara siguió especializándose en la producción industrial de bienes básicos, aunque este tipo de bienes pierde un importante peso relativo entre 1975 y 1988, por ejemplo en la rama de alimentos, bebidas y tabaco, el empleo se reduce de 29.0% a 24.0%; su valor agregado, de 32.6% baja a 23.3%; y, el número de establecimientos, de 11.3% a 6.8%. Sin embargo en su conjunto el sector manufacturero de la zona metropolitana de Guadalajara no se vio afectado ya que la inversión extranjera directa y otra de capital nacional se incrementó constantemente en la rama de los productos eléctricos, electrónicos y automotriz, instalándose empresas maquiladoras para la exportación y empresas que utilizan tecnologías de alto nivel. Se modifica así la estructura productiva de esta ciudad, primero en relación con la aportación de valor agregado, luego con el empleo, destacando de esta forma la manufactura de los bienes intermedios y duraderos (Pozos, 1996: 89-92; Garza y Rivera, 1994: 13-15).

Según su especialización económica tradicional durante esta fase de industrialización, Guadalajara mantuvo un ámbito territorial de influencia (con mayor o menor dominio) sobre las principales localidades de 7 estados del Occidente y Centro - Norte (Aguascalientes, Colima, Guanajuato, Jalisco, Michoacán, Nayarit y Zacatecas) conformada según un estudio de nodalización de llamadas telefónicas interurbanas de CONAPO (CONAPO, 1991) y los estudios de los movimientos demográficos centralizados por Guadalajara (Winnie, 1984:14; Velásquez y Papail, 1997).

Tradicionalmente se ha considerado que la ciudad de Guadalajara cumple una función predominantemente comercial para su entorno urbano-regional; y, efectivamente el *cociente de localización o índice de especialización económica* aplicado a la ZMG, utilizando el indicador del PIB, presenta en tal situación a las actividades comerciales, tanto en 1970 como en 1990 (Garza y Rivera, 1994: 73-77) En este último año, el transporte aparece como otra actividad especializante y complementario del comercio de Guadalajara. Sin embargo, al estimar el cociente en cuestión, utilizando como indicador a la PEA, las actividades predominantes de la ZMG, son más diversificadas: surge en primer lugar la industria manufacturera, al lado del comercio y el transporte, tanto en 1970 como en 1990 (Unikel, et al, 1978: 159; González, 1998) Esto significa que estas actividades fueron en esos periodos las principales en la base económica del crecimiento de Guadalajara, a la vez que aportaron los ingresos netos a la ciudad y generaron un "excedente" de empleos. Pero hay que precisar que la base económica estuvo determinada, en gran medida, hasta los años setenta, por las características socioeconómicas del entorno urbano-regional del Occidente.

Definitivamente, Guadalajara deja a partir de los años setenta de centralizar la región occidente para ciertos tipos de bienes y servicios, pero continua su dominación modificando la naturaleza de los bienes y servicios que centraliza. Algunas especificidades de los cambios se exponen como sigue:

- i) La estructura económica de la ZMG se ha vuelto, a partir de los años sesenta, más industrial. Guadalajara comenzó a cambiar con las crecientes inversiones industriales provenientes de México, Monterrey y del extranjero, con las cuales surgieron cada vez en mayor medida, medianas y grandes empresas productoras de bienes intermedios y algunas pocas de capital y duraderos. Industrialmente se hizo más moderna, aún en las ramas de los bienes básicos (Hernández, 1974; de la Peña, 1986; Garza y Rivera, 1994) pero con una base diversificada, ya que no ha abandonado, como ya se dijo, la centralidad en materia comercial, de transportes y de servicios especializados. La modernidad industrial condujo también a que el comercio y los servicios, continuaran con gran dinamismo y se modernizaran, para atender la demanda local y la de su región de influencia, puesto que entre 1960 y 1980 la concentración de PEA con alta calificación en servicios, comercio y transporte, en la ZMG respecto del total de la región occidente, creció de 44.2 % a 59.0 % (Pozos 1991: 8) Este crecimiento en las ocupaciones de coordinación y de alta calificación de las funciones terciarias, se ha desarrollado vinculado a la progresiva industrialización y a una ampliación de la planta manufacturera de exportación de la ZMG y de otras ciudades como Aguascalientes, dada a partir de las grandes empresas nacionales y transnacionales; y, por otra, debido al crecimiento y modernización de los mismos servicios, que extienden sus redes en la región Occidente, ante el crecimiento de las ciudades medias y del gran número de pequeñas ciudades emergentes en la región. En general esto supone un cambio en la naturaleza de la primacía regional de Guadalajara orientada hacia los servicios productivos y actividades de coordinación, que no se refleja en términos de mayor primacía demográfica dentro del sistema urbano regional del Occidente.
- ii) Otras ciudades capitales de los estados en el occidente han desarrollado exitosamente funciones de *centralidad* para sus *hinterlands*, por ejemplo, en los servicios de salud y educación universitaria y el comercio (aunque no por ello dejan de tener en buena parte una dependencia comercial de Guadalajara<sup>[3]</sup> o de la ciudad de México)

En consecuencia, en el ámbito urbano del occidente, Guadalajara pierde parte de su preeminencia tradicional a partir de los años setenta, que coincide con el agotamiento del modelo industrializador de sustitución de importaciones, continuando luego con las profundas crisis económicas de los años ochenta, donde se observa más notoria la disminución de su primacía regional (el cuadro 1 registra el comportamiento creciente de la preeminencia poblacional y su declinación antes dicha) Con el auge de la economía nacional a finales de la década de los años ochenta y en los primeros cuatro años de los noventa, la economía de Guadalajara es estimulada, su participación en la población urbana prácticamente se mantiene en los mismos niveles hasta 1995, pero el índice de primacía continua disminuyendo, ante el empuje de las 3 y 6 principales ciudades que le siguen en tamaño.

CUADRO 1  
PREEMINENCIA DE LA ZONA METROPOLITANA DE GUADALAJARA  
EN LA REGIÓN OCCIDENTE  
(PARTICIPACIÓN EN LA POBLACIÓN URBANA E ÍNDICE DE PRIMACÍA)

	1960	1970	1980	1990	1995
% DE LA POBLACIÓN URBANA	36.21	38.57	37.05	32.90	32.18
ÍNDICE DE PRIMACÍA:					

3 Ciudades	1.74	2.01	1.83	1.69	1.59
6 Ciudades	1.21	1.44	1.33	1.19	1.13

FUENTE: Elaborado con datos del INEGI (y otras dependencias del Gobierno Federal) VIII, IX, X y XI. Censos Generales de Población y Vivienda y Conteo de población de 1995. El índice se construye dividiendo la población de la ciudad mayor o primal, en este caso la ZMG, entre la suma de las poblaciones de  $n$  ciudades que le siguen en tamaño. Se eligieron tres y seis ciudades (Ver método en Unikel, Garza y Chiapetto, 1978).

En conclusión, durante los últimos 15 años, el crecimiento de Guadalajara tiende a fincarse en factores no regionales (mercados y capitales multinacionales y nacionales) ya que su primacía urbana regional decrece continuamente después del proceso de apertura en el nuevo modelo de desarrollo. En cierta forma, se observa también una correspondencia entre la emergencia de funciones socioeconómicas en las principales ciudades medias del Occidente que han frenado la creciente centralidad histórica de Guadalajara y la incorporación a esta ciudad de nuevas actividades industriales y de servicios globalizadas.

A continuación, se presentan los cambios en la estructura productiva y ocupacional de la zona metropolitana de Guadalajara (ZMG) para el periodo de 1988 a 1998, con el propósito de verificar las tendencias ya aludidas con relación a la nueva etapa de la producción manufacturera y, por otra parte, evaluar si los cambios ocupacionales en la economía de Guadalajara se ajustan o no a lo esperado por una ciudad que tiende a insertarse cada vez más en el proceso competitivo global.

## 2. Cambios en el perfil sectorial, productivo y ocupacional de la ZMG, 1988 Y 1998.

Esta sección intenta dar respuesta a dos cuestiones: ¿Si la manufactura tradicional de la ciudad mantiene, en esta década de análisis, la pérdida de importancia relativa a favor de las ramas de bienes intermedios, bienes de consumo duraderos y de capital? De ser afirmativa, indicaría la continuación de una tendencia ya detectada desde principios de los años ochenta y en consecuencia se estaría en condiciones de confirmar un cambio estructural en la base económica de crecimiento de Guadalajara, es decir alejándose de una dependencia de los mercados regionales y vinculándose más a los mercados nacionales e internacionales. Segundo ¿hasta qué grado, la economía de Guadalajara presenta algunas de las características ocupacionales que tipifican a las economías periféricas que se han insertado en la globalización informacional? A saber según M. Castells (1999) son:

- i) Un bajo ritmo de generación de empleos en la ocupación manufacturera (sin maquila de exportación) como consecuencia, de la economía abierta, del abaratamiento de la tecnología e insumos importados (y eventualmente también de la apreciación monetaria peso/dólar), aspectos que impactan negativamente al empleo y que no son compensados por el incremento en las ventas internas y externas)
- ii) Un rápido crecimiento de la ocupación en la industria maquiladora de exportación en general.
- iii) Transferencia de mano de obra hacia los servicios personales, sociales y distributivos, los cuales podrían tener mayor participación en el conjunto del empleo total de la ciudad.
- iv) Mayor participación relativa del empleo en las ramas de los servicios a la producción (debido a los procesos de desconcentración, diversificación y flexibilidad productiva)
- v) Menor dinámica para los puestos de mayor calificación y en contrapartida un predominio de aquellos de menor nivel de calificación, puesto que la nueva división internacional del trabajo se configura asignando a los países de menor desarrollo las actividades de menor contenido informacional.

En cuanto a la primera cuestión citada, el cuadro 2, muestra los datos de la estructura ocupacional en el sector manufacturero para la década de 1988 a 1998, observándose una estabilización en la participación de la rama de los alimentos y bebidas, pero una consistente y notoria pérdida en la participación de otras importantes y tradicionales ramas industriales de la ciudad: las industrias textiles, las industrias de las prendas de vestir y del cuero (básicamente calzado), que fueron mayormente afectadas por la apertura externa. Cuando se analiza otro indicador censal, es evidente que el conjunto de las industrias tradicionales de Guadalajara, orientadas a los bienes básicos y no duraderos en general, contemplan un escaso dinamismo en su capitalización, reflejándose en una fuerte disminución en la participación del valor total de los activos fijos de la manufactura de la ciudad, particularmente entre 1993 y 1998 (cuadro 3) Nuevamente, si se atiende a las actividades textiles, prendas de vestir y del cuero, éstas resienten de una mínima capitalización total y muy baja relación capital/trabajo, indicativo fiel de bajos niveles tecnológicos (cuadros 3 y 4) Esta descapitalización relativa de las industrias básicas en Guadalajara se correlaciona en varios casos con un desinterés de los empresarios locales (incluso de grandes empresas manufactureras) por la producción y un mayor interés por convertirse en importadores y comercializadores directos de bienes importados (por ejemplo, el caso de la gran fábrica de calzado Canadá)

**CUADRO 2**  
**ZMG : ESTRUCTURA DE LA OCUPACIÓN MANUFACTURERA SEGÚN SUBSECTOR DE ACTIVIDAD, 1988-1998 (Porcentajes)**

SUBSECTOR DE ACTIVIDAD MANUFACTURERA	1988	1993	1998
31. ALIMENTOS, BEBIDAS Y TABACO	24.01	24.84	23.45
32. TEXTILES, P. DE VESTIR E INDUSTRIA DEL CUERO	19.57	16.58	14.44
33. IND. DE LA MADERA, PCTOS. DE MADERA Y MUEBLES	4.53	5.17	5.31
34. PAPEL Y PCTOS. DE PAPEL, IMPRENTA Y EDITORIALES	51.79	51.54	47.62
Subtotal Bienes de Consumo no Duraderos	<b>51.79</b>	<b>51.54</b>	<b>47.62</b>
35. SUSTANCIAS QUÍMICAS, DER. DEL PETRÓLEO, DEL CARBÓN, DE HULE Y DE PLÁSTICO	16.57	16.88	16.29
36. PCTOS. MINERALES NO METÁLICOS (EXCLUYE DERIVADOS DEL PETRÓLEO Y CARBÓN)	5.32	4.66	5.94
37. INDUSTRIA METÁLICA BÁSICAS	2.25	1.02	0.74
Subtotal Bienes Intermedios	<b>24.14</b>	<b>22.56</b>	<b>22.97</b>
38. PCTOS. METÁLICOS, MAQUINARIA Y EQUIPO	23.38	24.53	28.15
39. OTRAS INDUSTRIAS MANUFACTURERAS	0.71	1.37	1.27
Subtotal Bienes de Consumo Duraderos y de Capital	<b>24.09</b>	<b>25.90</b>	<b>29.41</b>
TOTAL MANUFACTURA (Absolutos: número de personas ocupadas)	100.00 (148,592)	100.00 (176,912)	100.00 (257,762)

FUENTE: INEGI, Censos Económicos de 1989, 1994 y 1999.

**CUADRO 3**  
**ZMG : ACTIVOS FIJOS NETOS DE LA MANUFACTURA SEGÚN SUBSECTOR DE ACTIVIDAD, 1988-1998 (Porcentajes)**

SUBSECTOR DE ACTIVIDAD MANUFACTURERA	1988	1993	1998
31. ALIMENTOS, BEBIDAS Y TABACO	30.27	32.27	25.77
32. TEXTILES, P. DE VESTIR E INDUSTRIA DEL CUERO	7.14	5.67	4.85
33. IND. DE LA MADERA, PCTOS. DE MADERA Y MUEBLES	2.34	1.69	1.76
34. PAPEL Y PCTOS. DE PAPEL, IMPRENTA Y EDITORIALES	3.62	4.42	2.72
Subtotal Bienes de Consumo no Duraderos	<b>43.37</b>	<b>44.04</b>	<b>35.11</b>
35. SUSTANCIAS QUÍMICAS, DER. DEL PETRÓLEO, DEL CARBÓN, DE HULE Y DE PLÁSTICO	25.50	22.41	23.42
36. PCTOS. MINERALES NO METÁLICOS (EXCLUYE DERIVADOS DEL PETRÓLEO Y CARBÓN)	5.96	5.83	11.26
37. INDUSTRIA METÁLICA BÁSICA	1.28	5.39	4.32
Subtotal Bienes Intermedios	<b>32.75</b>	<b>33.62</b>	<b>39.01</b>
38. PCTOS. METÁLICOS, MAQUINARIA Y EQUIPO	23.71	22.04	25.62
39. OTRAS INDUSTRIAS MANUFACTURERAS	0.17	0.30	0.26
Subtotal Bienes de Consumo Duraderos y de Capital	<b>23.88</b>	<b>22.33</b>	<b>25.88</b>
TOTAL MANUFACTURA (absolutos en miles de pesos de 1993)*	100.00 (9,546,762)	100.00 (12,135,107)	100.00 (17,661,874)

\* Valores deflacionados con el índice nacional de precios al productor 1993=100.

FUENTE: Elaborado con datos del INEGI, Censos Económicos de 1989, 1994 y 1999 (los valores son registrados al 31 de Diciembre de cada año)

**CUADRO 4**  
**ZMG : RELACIÓN CAPITAL / TRABAJO EN LA MANUFACTURA, SEGÚN SUBSECTOR DE ACTIVIDAD, 1988-1998 (miles de pesos de 1993)\***

SUBSECTOR DE ACTIVIDAD MANUFACTURERA	1988	1993	1998
31. ALIMENTOS, BEBIDAS Y TABACO	81.0	89.1	75.3
32. TEXTILES, P. DE VESTIR E INDUSTRIA DEL CUERO	23.4	23.4	23.0
33. IND. DE LA MADERA, PCTOS. DE MADERA Y	33.1	22.4	22.7



MUEBLES			
34. PAPEL Y PCTOS. DE PAPEL, IMPRENTA Y EDITORIALES	63.3	61.1	42.2
Promedio Bienes de Consumo no Duraderos	<b>53.8</b>	<b>58.6</b>	<b>50.5</b>
35. SUSTANCIAS QUÍMICAS, DER. DEL PETRÓLEO, DEL CARBÓN, DE HULE Y DE PLÁSTICO	98.9	91.0	98.6
36. PCTOS. MINERALES NO METÁLICOS (EXCLUYE DERIVADOS DEL PETRÓLEO Y CARBÓN)	71.9	85.8	129.9
37. INDUSTRIA METÁLICA BÁSICA	36.7	362.5	399.7
Promedio Bienes Intermedios	<b>87.2</b>	<b>102.2</b>	<b>116.4</b>
38. PCTOS. METÁLICOS, MAQUINARIA Y EQUIPO	65.1	61.6	62.4
39. OTRAS INDUSTRIAS MANUFACTURERAS	15.9	15.0	14.2
Promedio Bienes de Consumo Duraderos y de Capital	<b>63.7</b>	<b>59.2</b>	<b>60.3</b>
TOTAL MANUFACTURA	64.2	68.6	68.5

\* La relación K/T es dada por el cociente de activos fijos netos/población ocupada. Los valores son deflacionados con el índice nacional de precios al productor 1993=100.

FUENTE: Elaborado con datos de los Censos Económicos de 1989, 1994 y 1999 (los valores son registrados al 31 de Diciembre de cada año)

#### CUADRO 5

ZMG : VALOR AGREGADO (CENSAL BRUTO) DE LA MANUFACTURA SEGÚN SUBSECTOR DE ACTIVIDAD, 1988-1998 (Porcentajes)

SUBSECTOR DE ACTIVIDAD MANUFACTURERA	1988	1993	1998
31. ALIMENTOS, BEBIDAS Y TABACO	33.37	39.53	28.30
32. TEXTILES, P. DE VESTIR E INDUSTRIA DEL CUERO	8.66	7.44	5.73
33. IND. DE LA MADERA, PCTOS. DE MADERA Y MUEBLES	1.60	2.34	2.06
34. PAPEL Y PCTOS. DE PAPEL, IMPRENTA Y EDITORIALES	3.29	2.46	2.77
Promedio Bienes de Consumo no Duraderos	<b>46.92</b>	<b>51.78</b>	<b>38.85</b>
35. SUSTANCIAS QUÍMICAS, DER. DEL PETRÓLEO, DEL CARBÓN, DE HULE Y DE PLÁSTICO	21.69	20.81	27.92
36. PCTOS. MINERALES NO METÁLICOS (EXCLUYE DERIVADOS DEL PETRÓLEO Y CARBÓN)	2.42	4.89	5.35
37. INDUSTRIA METÁLICA BÁSICA	0.85	0.99	1.20
Promedio Bienes Intermedios	<b>24.96</b>	<b>26.69</b>	<b>34.47</b>
38. PCTOS. METÁLICOS, MAQUINARIA Y EQUIPO	27.87	20.95	26.27
39. OTRAS INDUSTRIAS MANUFACTURERAS	0.26	0.59	0.41
Promedio Bienes de Consumo Duraderos y de Capital	<b>28.13</b>	<b>21.54</b>	<b>26.68</b>
TOTAL MANUFACTURA (absolutos en miles de pesos de 1993)**	100.00 (7,189,082)	100.00 (12,484,051)	100.00 (14,370,809)

\* Valores deflacionados con el índice nacional de precios al productor 1993=100.

FUENTE: INEGI, Censos Económicos de 1989, 1994 y 1999.

Por otra parte, los cuadros 2 a 4 también confirman el cambio en el perfil ocupacional y productivo de la zona metropolitana de Guadalajara, asociado a la decreciente importancia relativa de las industrias tradicionales y hacia un mercado dinamismo en las industrias de bienes intermedios y de bienes de consumo duradero y de capital, entre 1988 y 1998. Las primeras en lo que se refiere a su mayor participación en los activos fijos y en el alto coeficiente capital/trabajo y las segundas en el empleo. Finalmente y de manera consecuente, en lo que se refiere a los indicadores de la producción y la productividad (cuadros 5 y 6) las industrias de bienes intermedios ganan decisivamente terreno sobre las industrias tradicionales (de bienes de consumo no duradero), las primeras elevan persistentemente su participación a lo largo del periodo en 10 puntos porcentuales, para ubicarse en poco más de un tercio del valor agregado bruto de la manufactura total de la ciudad; además incrementan su productividad por persona ocupada de 50 mil pesos a 83.7 miles de pesos (constantes de 1993) Mientras tanto los bienes tradicionales si bien incrementan su participación en el valor agregado entre 1988 y 1993, al igual que su productividad, para la segunda parte del periodo de análisis (1993-1998) después de la crisis y con la entrada de México a los tratados de libre comercio, ven caer su participación en el valor agregado en de 51.8% a 38.9% y su productividad se desliza de 70.9 miles de pesos

a 45.5 miles (pesos constantes de 1993) Por lo que respecta a los bienes duraderos y de capital, éstos no responden con un dinamismo en su aportación productiva superior al promedio de la industria en su totalidad, sino hasta los últimos 5 años del periodo. En conclusión, la respuesta a la primera cuestión planteada al inicio de esta sección es que se confirma el cambio en la composición de las actividades manufactureras de Guadalajara, atribuyéndose, por un lado, una mayor relevancia a la producción con crecientes niveles de productividad de los bienes intermedios, duraderos y de capital asociado a mercados supra regionales y globales; y, por otro, una menor participación productiva y ocupacional, y decreciente productividad de los bienes industriales en que tradicionalmente había sustentado su base económica de crecimiento y proveído a su extensa región de influencia.

CUADRO 6  
ZMG : PRODUCTIVIDAD DE LA MANO DE OBRA OCUPADA EN LA MANUFACTURA, SEGÚN SUBSECTOR DE ACTIVIDAD, 1988-1998 (miles de pesos de 1993) \*

SUBSECTOR DE ACTIVIDAD MANUFACTURERA	1988	1993	1998
31. ALIMENTOS, BEBIDAS Y TABACO	67.2	112.3	67.3
32. TEXTILES, P. DE VESTIR E INDUSTRIA DEL CUERO	21.4	31.7	22.1
33. IND. DE LA MADERA, PCTOS. DE MADERA Y MUEBLES	17.1	32.0	21.6
34. PAPEL Y PCTOS. DE PAPEL, IMPRENTA Y EDITORIALES	43.3	35.1	34.9
Promedio Bienes de Consumo no Duraderos	<b>43.8</b>	<b>70.9</b>	<b>45.5</b>
35. SUSTANCIAS QUIMICAS, DER. DEL PETROLEO, DEL CARBÓN, DE HULE Y DE PLÁSTICO	63.3	87.0	95.6
36. PCTOS. MINERALES NO METALICOS (EXCLUYE DERIVADOS DEL PETROLEO Y CARBON)	22.0	74.1	50.2
37. INDUSTRIA METÁLICA BASICAS	18.3	68.4	90.1
Promedio Bienes Intermedios	<b>50.0</b>	<b>83.5</b>	<b>83.7</b>
38. PCTOS. METÁLICOS, MAQUINARIA Y EQUIPO	57.7	60.3	52.0
39. OTRAS INDUSTRIAS MANUFACTURERAS	17.7	30.4	18.2
Promedio Bienes de Consumo Duraderos y de Capital	<b>56.5</b>	<b>58.7</b>	<b>50.6</b>
TOTAL MANUFACTURA	48.4	70.6	55.8

\*La productividad es estimada a partir del cociente: valor agregado censal bruto/población ocupada.

FUENTE: Elaborado con datos de los Censos Económicos de 1989, 1994 y 1999.

Para atender la segunda cuestión planteada sobre las características ocupacionales que tipificarían a una economía periférica de una ciudad, que en cierto grado se ha insertado en la globalización informacional, se procede con los aspectos sobre lo previsto con el bajo ritmo de generación de empleos en la ocupación manufacturera sin maquila de exportación y el análisis sectorial de la mano de obra en el conjunto de la economía de la ZMG.

De acuerdo con los datos de los censos económicos vertidos en el cuadro 7, efectivamente la manufactura sin maquila de exportación en la ZMG genera una dinámica de ocupación que en promedio es menor a la del conjunto de los principales sectores de la economía privada formal mostrados en este cuadro, por lo que su participación se reduce de 40.4% a 35.1% entre 1988 y 1993, que equivale básicamente a la disminución que resiente la manufactura en general ya que la industria maquiladora de exportación no crece prácticamente en su participación dentro de la estructura ocupacional en estos cinco años. Para el siguiente quinquenio, en el cual entran en vigor los tratados de libre comercio con Norteamérica y otros países, la manufactura sin maquila de exportación vuelve a caer ligeramente, cuantificando su presencia en 34.1%. Por otra parte, la maquila de exportación acelera su presencia en la ZMG (particularmente en el grupo de la electrónica) elevando su proporción de 1.8% a 4.2%. En síntesis, la manufactura sin maquila de exportación en la ZMG, se ha convertido en un sector que si bien no es aún un generador de desocupación absoluta de mano de obra, contempla un limitado dinamismo de ocupación de mano de obra dentro del conjunto de actividades privadas formales que registran los censos económicos. También, se podría hablar de una transferencia de puestos de trabajo hacia la industria maquiladora de exportación cuya calidad de empleos es menor con respecto a las modalidades de contratación que prevalecen en la misma (subcontratación y por tiempo determinado menor a un año) a los

menores sueldos con relación a los contractuales en la manufactura en general y a las características de la ocupación femenina, que es predominante (aproximadamente un 80% de mujeres en el total de obreros)

## CUADRO 7

ZMG: POBLACIÓN OCUPADA SEGÚN SECTOR Y SUBSECTOR DE ACTIVIDAD EN LA ECONOMÍA FORMAL PRIVADA (SEGÚN CENSOS ECONÓMICOS), 1988, 1993 Y 1998.

(Porcentajes)

SECTOR Y SUBSECTOR DE ACTIVIDAD ECONÓMICA	1988	1993	1998
MANUFACTURA	42.18	36.95	38.30
INDUSTRIA MAQUILADORA DE EXPORTACIÓN 1/	1.77	1.80	4.20
<b>MANUFACTURA SIN INDUSTRIA MAQUILADORA DE EXPORTACIÓN</b>	<b>40.41</b>	<b>35.15</b>	<b>34.10</b>
<b>COMERCIO</b>	<b>33.04</b>	<b>35.29</b>	<b>29.63</b>
61. COMERCIO AL POR MAYOR	8.16	9.60	8.55
62. COMERCIO AL POR MENOR	24.88	25.69	21.08
<b>SERVICIOS PRIVADOS NO FINANCIEROS</b>	<b>24.78</b>	<b>27.77</b>	<b>32.07</b>
82. ALQUILER Y ADMON. DE BIENES INMUEBLES	0.71	0.60	0.73
83. ALQUILER DE BIENES MUEBLES	0.33	0.54	0.31
92. SERV. EDUCATIVOS, DE INVESTIGACIÓN MÉDICOS, A. SOCIAL, A. CIVILES Y RELIGIOSOS	5.38	5.89	5.50
93. RESTAURANTES Y HOTELES	6.26	6.57	6.04
94. SERV. DE ESPARCIMIENTO, CULTURALES, RECREATIVOS Y DEPORTIVOS	1.56	1.52	1.16
RAMA 9510. SERV. PROFESIONALES, TÉCNICOS ESPECIALIZADOS A EMPRESAS (EXCLUYE SERV. PERSONALES)	<b>3.16</b>	<b>5.05</b>	<b>10.94</b>
96. SERV. DE REPARACIÓN Y MANTENIMIENTO	5.14	5.20	4.76
97. SERV. RELACIONADOS CON LA AGRICULTURA, GAN. TRANSPORTES, FINANCIEROS Y COMERCIALES	0.81	1.07	1.34
SERVICIOS PERSONALES Y OTROS NO ESPECIFICADOS	1.43	1.33	1.29
TOTAL ZMG 2/	100.00 (352,278)	100.00 (478,798)	100.00 (673,040)

1/ La ocupación de la industria maquiladora de exportación se refiere al total de Jalisco.

2/ Incluye la ocupación de los sectores de la manufactura, el comercio y los servicios no financieros. Los datos de los sectores de la construcción, comunicaciones y transportes y servicios financieros no son disponibles por municipio en los censos económicos. La clasificación a dos dígitos representa el subsector de actividad y a cuatro dígitos la rama de actividad.

FUENTE: Elaborado con datos del INEGI, Censos Económicos de 1989, 1994 y 1999; INEGI, información de la Industria Maquiladora de Exportación.

En un segundo término, si se atiende a la misma información del cuadro 7, delimitada por la economía privada registrada (según la cobertura de la información de censos económicos a escala municipal), se observa un dinamismo sobresaliente en la rama de los servicios profesionales y técnicos a las empresas, su participación pasa de 3.16% a 10.94% cuyo incremento no sólo no es superado por ningún otro subsector de los incluidos en este cuadro, sino que salvo la industria maquiladora de exportación, no hay otro subsector de actividad que registre un incremento sustancial en su participación relativa. Tal dinamismo constituye una segunda característica de importancia que se espera de toda gran ciudad insertada en la reestructuración económica. En particular un tercer aspecto que puede verse para el caso de la ZMG, es el mínimo incremento e incluso retroceso (en el segundo quinquenio, cuadro 7) en la participación de la ocupación del comercio al por mayor, también indicativo del repliegue de la función económica tradicional de esta ciudad como centro oferente de bienes a la región del Occidente y hacia el Pacífico Norte.

Dado que la información de censos económicos a escala municipal no incluye la ocupación relegada en el sector económico informal (por definición no registrada) y la generada por el sector público, en este sentido, es necesario introducir la información de la ocupación proveniente de los censos de población para observar la distribución en la totalidad de la economía de Guadalajara (como zona metropolitana) Esta se presenta en el cuadro 8, en el cual es factible anotar los siguientes puntos:

**CUADRO 8**  
ZMG: POBLACIÓN OCUPADA POR SECTOR DE ACTIVIDAD  
ECONÓMICA, 1990 y 2000 (Porcentajes)

SECTOR DE ACTIVIDAD	1990	2000
AGRICULTURA, GANADERÍA, SILV. Y PESCA	2.17	1.30
MINERÍA	0.09	0.07
EXTR. DE PETRÓLEO Y GAS	0.13	0.00
<b>INDUSTRIA MANUFACTURERA</b>	<b>28.51</b>	<b>26.63</b>
ELECTRICIDAD Y AGUA	0.54	0.34
CONSTRUCCIÓN	7.60	7.10
COMERCIO	<b>18.82</b>	<b>21.38</b>
TRANSPORTES Y COMUNICACIONES	5.21	4.72
SERVICIOS FINANCIEROS	2.37	1.78
ADMINISTRACIÓN PÚBLICA Y DEFENSA	3.32	3.53
<b>SERVICIOS COMUNALES Y SOCIALES</b>	<b>9.25</b>	<b>9.05</b>
<b>SERVICIOS PROFESIONALES Y TÉCNICOS</b>	<b>2.55</b>	<b>3.53</b>
RESTAURANTES Y HOTELES	4.27	5.20
SERV. PERSONALES Y MANTENIMIENTO	11.78	11.67
NO ESPECIFICADO	3.39	3.69
TOTAL RELATIVO	100.00	100.00
TOTAL ABSOLUTO	951,446	1,469,706

FUENTE: Elaborado con datos del INEGI, XI y XII Censos Generales de Población y Vivienda.

- i) Al incluir a la totalidad de la ocupación de la ciudad se diluye la claridad de los cambios en las participaciones de los subsectores de actividad, con respecto a la información mostrada en el cuadro 7. Sin embargo, aún así es posible detectar una reducción en la manufactura en general, 28.5% a 26.6% entre el año de 1990 y el 2000. Así como un incremento en la ocupación de los servicios profesionales y técnicos.
- ii) Aquí sin embargo las actividades del comercio incrementan su participación debido a que contabiliza también la ocupación en el comercio informal, que es mucho más dinámico que el registrado en la economía formal de la ZMG <sup>[4]</sup>.
- iii) Salvo mínimos incrementos en la ocupación relativa de los servicios de la administración pública y de restaurantes y hoteles, en el resto de los sectores hay reducciones en su participación relativa, incluso en aquellos sectores de actividad donde podría esperarse un mayor dinamismo y a donde se supone que podrían transferirse los empleos perdidos en la manufactura, como son los servicios comunales y sociales y los servicios personales; sin embargo, aún siguen siendo después de la manufactura y el comercio, los de mayor relevancia.
- iv) A pesar del crecimiento de los servicios financieros, particularmente con la reprivatización de los bancos y el auge de las actividades bursátiles, la ocupación relativa en este sector disminuye visiblemente, lo cual se traduce en un magro incremento absoluto en el número de personas ocupadas (22.5 miles de personas en el año de 1990 y 26.2 miles en 2000) resultado de la reestructuración y transnacionalización de este sector después de la crisis de 1994.

**CUADRO 9**  
ZMG: POBLACIÓN OCUPADA POR NIVEL DE CALIFICACIÓN, SEGÚN GRUPOS DE  
OCUPACIÓN 1990 Y 2000 (Porcentajes)

GRUPO DE OCUPACIÓN	1990	2000
11 PROFESIONALES	4.26	5.64
21 FUNCIONARIOS Y DIRECTIVOS	3.74	3.28
<b>SUBTOTAL CALIFICACIÓN ALTA 1/</b>	<b>8.00</b>	<b>8.92</b>
12 TÉCNICOS	4.18	3.49
13 TRABAJADORES DE LA EDUCACIÓN	3.29	3.61
14 TRABAJADORES DEL ARTE	1.19	1.15
51 Y 61 INSPECTORES Y SUPERVISORES	2.27	5.18
62 OFICINISTAS	11.65	8.10

<b>SUBTOTAL CALIFICACIÓN MEDIA</b>	<b>22.58</b>	<b>21.53</b>
41 TRABAJADORES AGROPECUARIOS	1.91	1.13
52 ARTESANOS Y OBREROS	21.33	20.21
53 OPERADORES DE MAQUINARIA FIJA	7.85	7.71
54 AYUDANTES Y SIMILARES	4.80	3.59
55 OPERADORES DE TRANSPORTE	5.43	4.41
71 COMERCIANTES Y DEPENDIENTES	14.07	16.74
72 TRABAJADORES AMBULANTES	2.74	2.62
81 TRABAJADORES EN SERVICIOS PERSONALES 2/	6.58	7.09
82 TRABAJADORES DOMÉSTICOS	2.84	3.66
83 PROTECCIÓN Y VIGILANCIA	1.87	2.38
<b>SUBTOTAL CALIFICACIÓN BAJA</b>	<b>69.42</b>	<b>69.54</b>
<b>TOTAL 3/</b>	100.00 (936,050)	100.00 (1,437,047)

1/ Los niveles de calificación se determinaron estadísticamente, según el número de años de escolaridad requeridos para desempeñar la ocupación.

2/ El grupo de ocupación 81 aparece como "Trabajadores en Servicios Públicos" en el Censo de 1990.

3/ El total absoluto no incluye a la población ocupada no especificada según grupos de ocupación.

FUENTE: Elaborado con datos del INEGI, XI y XII Censos de Población.

En relación a la clasificación de la población por grupos de ocupación (cuadro 9) no se percibe una modificación palpable cuando se le trata por grandes niveles de calificación, sin embargo, algunos detalles interesantes pueden ser detectados, a saber:

- i) Los grupos de ocupación con calificación alta se mueven ligeramente en dirección ascendente, particularmente para el grupo 11 ("profesionales") que lo hace de 4.3% a 5.6% entre 1990 y 2000. Mientras tanto los promedios de los grupos de calificación media y baja disminuyen ligeramente o permanecen igual, dando así una visión general de que la estructura de ocupaciones se vuelve un poco favorable hacia los estratos de mayor calificación; rasgo que coincide con la fuerte dinámica ya observada en lo concerniente a las actividades de los servicios profesionales y técnicos especializados. Por lo demás, esto indica que el proceso impulsado a partir de la nueva división internacional del trabajo, o sea el de transferencia de puestos de baja calificación en los ramos manufactureros de los países centrales (en nuestro caso predominantemente de EE.UU.) hacia la ZMG, no es suficiente para agrandar la base de la estructura ocupacional de esta ciudad según niveles de calificación. En cierta forma, se trata de un aspecto que permite concluir contra lo esperado en relación con la dinámica de la estructura ocupacional, según niveles de calificación; es decir, el de una tendencia hacia una base más ancha y por tanto de mayor demanda relativa de puestos de trabajo de baja calificación con relación a los de mayor nivel.
- ii) Los grupos de ocupación con calificación media disminuyen en un casi un punto porcentual, siendo particularmente el grupo 62 ("oficinistas") el que mayormente pierde presencia (de 11.6% a 8.1% entre 1990 y 2000) muy posiblemente debido a la reorganización empresarial y el uso más generalizado de la tecnología informacional (por ejemplo, en los servicios se detectó líneas arriba que el área de los financieros es uno de los que crecen más lentamente en materia de ocupación de mano de obra); el grupo 12 ("técnicos") también baja ligeramente, a pesar de que frecuentemente declaran los representantes empresariales no tener una oferta suficiente para estas ocupaciones; la reducción en este caso, corresponde con la limitada dinámica de ocupación que muestra la manufactura en su totalidad.
- iii) En general el conjunto de grupos de ocupación con baja calificación permanece constante en la década de los años noventa. El grupo más relevante, el 52 ("artesanos y obreros") apenas si modifica su participación en esta estructura ocupacional, disminuyendo un punto porcentual, pero el grupo 54 ("ayudantes y similares") que normalmente se encuentran en una jerarquía menor que éstos, disminuyen sensiblemente su representatividad; una disminución similar sucede con los "operadores de transporte". El grupo de los "comerciantes y dependientes" muestra un crecimiento relativamente más notorio en este nivel; sin embargo, por una parte se trata de un grupo heterogéneo al incluir a los comerciantes empleadores (de distinta capacidad empresarial) y, por otra, a los trabajadores por cuenta propia (no registrados) ocupados en el comercio, que son precisamente los que más rápido crecen. En contrapartida a dichas disminuciones en este nivel de baja calificación, se verifica una transferencia de ocupaciones hacia los servicios personales, domésticos y vigilancia, que ascienden

ligeramente en su aportación relativa; explicado posiblemente por el crecimiento de los ingresos personales de los grupos de mayor calificación y por la mayor inseguridad urbana.

### 3. Conclusiones

Definitivamente Guadalajara es una metrópoli cuya economía se encuentra inmersa en un proceso de reestructuración, iniciado desde el abandono de la estrategia de industrialización sustitutiva, que toma forma con el modelo de desarrollo asociado a procesos de globalización económica. Esto se refleja para la ciudad en varias dimensiones que en cierto grado se encuentran interrelacionadas; algunas de estas dimensiones que fueron encontradas, son:

- i) Un cambio en los factores de crecimiento económico, con el cual Guadalajara abandona la gran dependencia de la base económica respecto de los mercados delimitados por la región Occidente y se reduce por tanto su primacía urbana e influencia socioeconómica sobre la misma, aunque se percibe una modificación en la naturaleza de su primacía a partir de los bienes y servicios de alto rango de especialización con que sigue atendiendo la demanda regional, quizá reflejado en el alto crecimiento de los empleos profesionales y técnicos especializados; pero, que no se manifiesta necesariamente en mayor concentración relativa de población o de producto <sup>[5]</sup>.
- ii) Se reestructura el sector manufacturero de Guadalajara y al hacerlo disminuye el ímpetu de los subsectores de las industrias tradicionales (tanto en la importancia relativa de su producción como de su capitalización y productividad); por otra parte, se estimula el crecimiento y productividad de las manufacturas de bienes intermedios y de consumo duradero, así como de los bienes de capital, manifestando con esto una reorientación industrial, asociada a capitales y mercados extra regionales (nacionales y extranjeros) y más vinculada a las redes de empresas que operan globalmente.
- iii) Sobre esto último sobresale el crecimiento de la industria maquiladora de exportación que en parte compensa el decrecimiento relativo de la ocupación en el sector de la manufactura exhibido en la década de 1988 a 1998, aunque su demanda laboral está dirigida hacia la contratación de mujeres, y la calidad y remuneraciones de sus empleos son menores en general a los ofrecidos en la industria no-maquiladora.
- iv) Otro sector de actividad económica que comparte con la manufactura una fuerte modernización y reorganización y cuyos efectos se manifiestan también en un acentuado decrecimiento relativo de la ocupación, es el sector de los servicios financieros.
- v) Finalmente, otro rasgo relevante de la reestructuración económica de Guadalajara es el alto dinamismo de la ocupación en la rama de los servicios productivos (servicios profesionales y técnicos especializados dirigidos a las empresas) al grado que determina un mayor predominio relativo para la clase de grupos de ocupación de alto nivel de calificación (su participación llega a casi 9 % de la ocupación total en el año 2000), con lo cual se concluye que la generación de ocupaciones en la última década del siglo XX se estructura favoreciendo relativamente más a las posiciones de trabajo de mayor calificación, ante el decrecimiento de los grupos de calificación media y la estabilización de los de baja calificación (en aproximadamente un 70% de la ocupación total).
- vi) Se verifica una transferencia de ocupaciones hacia los servicios personales, domésticos y vigilancia, que ascienden ligeramente en su aportación relativa; explicado, posiblemente por el crecimiento de los ingresos personales de los grupos de mayor calificación y posiblemente por la mayor inseguridad urbana.
- vii) Aunque a partir de la comparación de la información suministrada por los censos de población y económicos, no se puede contabilizar la aportación del sector económico informal a la ocupación total para los distintos sectores de actividad, se logra al menos una medida precisa de cómo el comercio informal es el componente que estimula la ocupación en este importante sector económico distributivo, ya que el comercio formal pierde relevancia en el total de la ocupación generada por la economía privada con registro. Además, este sector junto con el sector de los servicios personales y mantenimiento, definitivamente concentran la mayoría de los trabajadores por cuenta propia informales, los cuales son un indicador fiel de las limitaciones de la economía formal urbana para generar una oferta suficiente de empleos, no sólo para la población de baja calificación sino también de los grupos de ocupación de nivel medio.

En general los incisos expuestos sintetizan algunas dimensiones ocupacionales y productivo sectoriales del proceso particular de modernización o reestructuración económica que actualmente se despliega en la ciudad de Guadalajara en el marco de un modelo de desarrollo que prioriza la apertura y la competitividad económica a escala global.

### Bibliografía

- Borja, Jordi y Castells M. (1997) *Local y global. La gestión de las ciudades en la era de la información*, Taurus, Madrid.
- Castells, Manuel (1999) *La era de la información. Economía, sociedad y cultura*. Vol. I, Siglo XXI Editores, México.
- CONAPO (1991), *Sistema de ciudades y distribución espacial de la población en México*. Tomos I y II, México.
- De la Peña, Guillermo (1986) "Mercados de trabajo y articulación regional: apuntes sobre el caso de Guadalajara y el Occidente mexicano" en *Cambio Regional, mercado de trabajo y vida obrera en Jalisco*, El Colegio de Jalisco, México.
- De Mattos, Carlos (1998) "Reestructuración, globalización, nuevo poder económico y territorio en Chile de los noventa." En De Mattos, Daniel Hiernaux, Restrepo Botero (coords.) *Globalización y Territorio, Impactos y Perspectivas*. P. Universidad Católica de Chile/ FCE, México.
- Escobar, Agustín (1986) *Con el Sudor de tu Frente*. Guadalajara, El Colegio de Jalisco.
- Garza, Gustavo y Salvador Rivera (1994) *Dinámica Macroeconómica de las ciudades en México*, Tomo I INEGI / COLMEX / IIS UNAM, Aguascalientes, México.
- Giddens, Anthony (1970) *The consequences of modernity*. California, Stanford University Press.
- Gilbert, Alan (1998) "World cities and the urban future: The view from Latin America". En Lo, Fu-Chen/ y Yue-Man Yeung (eds), 1998; *Globalization and the world of large cities*. UNU Press. Tokio.
- González, Rodríguez S. Manuel (1998) "Cambios en la especialización económica de las ciudades del occidente de México, 1960-1990" en *Carta Económica*, Núm. 58 Enero-Febrero, INESER Universidad de Guadalajara, México.
- Hernández, 1974;
- Lo, Fu-Chen/Yue-Man Yeung (1998) eds. *Globalization and the world of large cities*. UNU Press, Tokio
- Padilla Dieste, Cristina (1997) *Todo queda en familia. El mercado de abastos de Guadalajara*, Universidad de Guadalajara.
- Parnreiter, Christof (2002) "Mexico: The Making of a Global City". En Saskia Sassen (ed) *Global Networks, Linked Cities*. Routledge, London.
- Pozos P., Fernando (1991) "Primacía urbana regional en el occidente de México" en *Tiempos de Ciencia*, núm25 Oct- Dic. Universidad de Guadalajara.
- Pozos, P. Fernando (1996) *Metrópolis en reestructuración: Guadalajara y Monterrey 1980-1989*, Universidad de Guadalajara, México.
- Robert Bryan (1989) "Employment Structure, Life Cycle, and Life Chances: Formal and Informal Sectors in Guadalajara" en Portes, Castells y Benton (Eds) *The Informal economy: studies in advanced and less developed countries*, The Johns Hopkins University Press.
- Rodríguez, Bautista Juan Jorge (1999) "Distribución territorial de las empresas en México" en rev. *Carta Económica Regional*, núm. 66, Universidad de Guadalajara, Mayo-Junio.
- Unikel, L. G. Garza y C. Chiapetto (1976) El desarrollo Urbano de México. Diagnóstico e implicaciones futuras. *El Colegio de México, México*.
- Velázquez, Luis A y Jean Papail (1997) *Migrantes y transformación económica sectorial. Cuatro ciudades del occidente de México*, Universidad de Guadalajara, México.
- Winnie, W. William Jr. (1984) *La movilidad demográfica y su incidencia en una región de fuerte emigración. El caso del Occidente de México*, Universidad de Guadalajara, México.

## **An Empirical Study on Shopping Behavior in the ICT Era –Toward Demand Forecast of Shopping-related Trips in Japan–**

Tokio Otsuka,\* Hiroyuki Someya,\* Toshiya Jitsuzumi,\*\*Hitoshi Mitomo, \*\*\*  
\*Doctoral student, \*\*Doctor in Science, and \*\*\*Doctor in Engineering  
School of Global Information and Telecommunications Studies  
Waseda University, Japan.  
[mitomo@giti.waseda.ac.jp](mailto:mitomo@giti.waseda.ac.jp)

### **Abstract**

The purpose of this research is to ascertain how the advancement of Information and Telecommunication Technology (ICT) changes people's behavior as well as the demand structure of

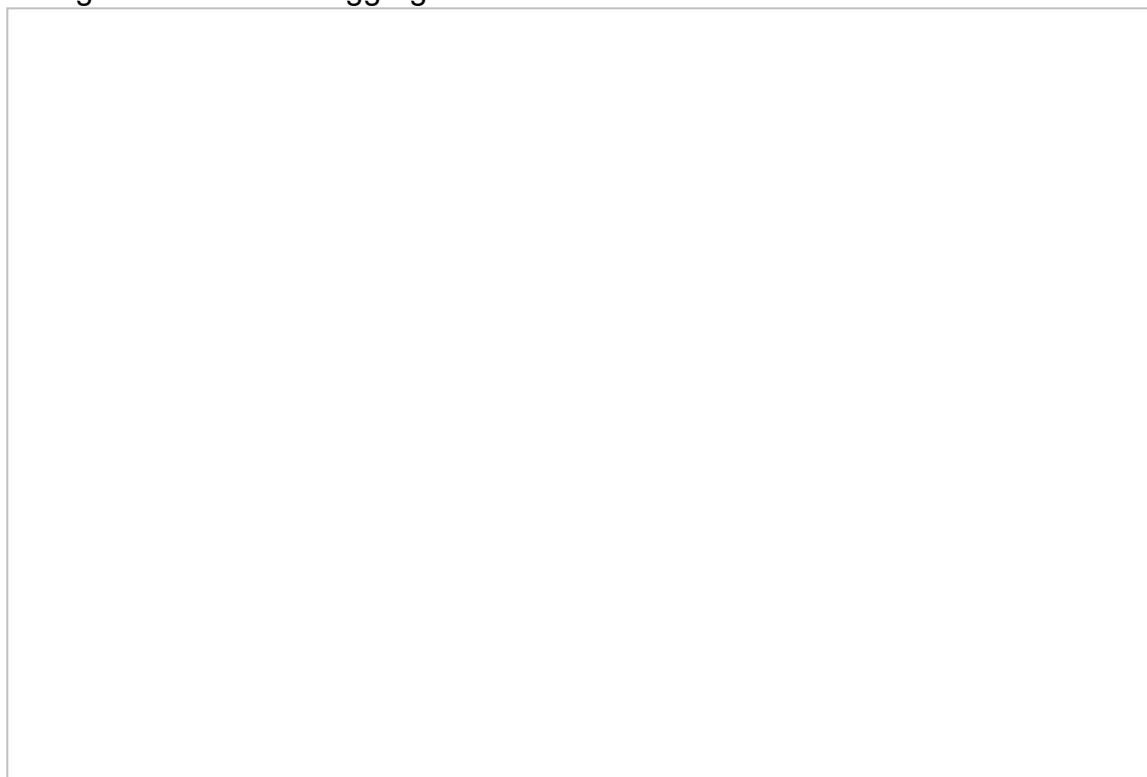
transportation. In this paper, we especially focused on purchasing behavior and shopping-related trips as derived demand. As an empirical study, we conducted a questionnaire survey in two locations in Japan; the major metropolis of Tokyo and the smaller regional city of Nagasaki. The survey inquired into selection factors between retail shops and Internet or catalog-order shops. We also turned our attention to the information gathering process involved in purchasing goods, which is certainly influenced by newly developed forms of information technology, such as the Internet and e-mail.

Although we were unable to elucidate a clear relationship between individual transportation-related attributes and purchasing mode selection, the results show that (1) individual attributes related to Internet-use positively affect the information gathering stage and the mode selecting stage, (2) the respondents' valuation of 'ease of purchasing activities' positively affects selection of Internet and catalog-order shops in the purchasing mode selection, and (3) the difference in location affects the information gathering process, but not the mode selection process.

## 1. Introduction

Developments in ICT have caused unprecedented transformations in people's behavioral patterns and their sense of values, as well as the institutions and systems to which they belong to. The interaction of all of these effects has created changes in our society as a whole, including regional communities,

urban cities and the national level. Figure 1<sup>[6]</sup> shows the impact that ICT has had on individual excursion (transportation) patterns, which are divided into specific activities. The interaction of such changes has led to an aggregate transformation in



transportation demand.

To date, no concrete conclusion has been drawn as to whether the relationship between information network-usage and transportation network-usage is substitutional or complimentary. The developments in ICT offer additional options for people to communicate with each other and make such options cheaper, and, as a result, transportation demand has ultimately undergone change. Those who

assert that ICT should substitute transportation-use assume that telecommunications networks reduce the need for face-to-face communication, and that demand for "real excursions" will decrease. On the



other hand, people who believe that ICT will complement transportation-use consider that ICT allows persons and organizations, located in geographically distance places, to communicate with each other, and subsequently, such persons interact during real excursions. The research focus of this paper deals with changes in purchasing behavior and an analysis of the relationship between transportation demand and advancements in ICT. By narrowing down our research objective we are able to obtain more concrete results.

Previous studies have analyzed the purchasing process conducted by consumers for both retail shops and Internet shops (Otsuka et al, 2002; Mitomo et al, 2002; Someya et at, 2003). In an empirical study regarding ticket-purchasing activities, using compiled consumer stated preference (SP) data it was shown that the transportation costs required to travel to retail shops positively cause consumers to use Internet shops; meaning that retail shops and Internet shops have a substitutional relationship in respect to distance. An analysis of SP data shows that the type of Internet shop and the method of payment used in Internet shopping also affect the choice between retail and Internet shops. Meanwhile, another survey involved the use of revealed preference (RP) data and focused on book purchases as an example. In this analysis, the influence of transportation costs was not found to be significant. It was shown that an individual's computer/Internet usage environment and their PC experience positively influences their purchase activities at Internet shops, and at the same time also positively influences their purchases at normal retail shops. The reason for this surprising result is assumed to be that a certain amount of people become intrigued by a book's contents during Internet browsing, and then choose a retail shop for their purchase. It is clear that the information gathering process is very important to understanding the influence that ICT has on purchasing activities, and in considering its derived transportation demand. Therefore, in this paper, we focused on the selection of purchasing methods as well as the information gathering process for purchasing, and conducted a questionnaire survey and subsequent analysis.

Salmon and Koppelman (1988) proposed a framework for the selection between retail shops and catalog-order shops (teleshopping), pertaining to the information gathering process during purchasing activities. They assumed that a consumer who enters a market (1) chooses an information gathering source and then compiles information on products, and (2) evaluates this information and decides whether or not to make a purchase. They called this two-phase process *shopping*.

Our research framework also involves a two-step model of shopping. In the first step, we consider the influence of newly advanced information gathering methods such as the Internet and e-mail, and in the second step consider purchasing mode selection in terms of three sources; retail shops, catalog-order shops, and Internet shops.

For the information gathering process, we inquire about an individual's 'willingness-to-pay for merchandise information,' and analyze the factors which affect it. We use the Tobit Model for this analysis. For the purchasing process, we analyze the factors of purchasing mode selection among retail, catalog-order, and Internet shops. We asked university students questions during a virtual purchasing-processes simulation in our questionnaire survey, and analyzed the resultant data using the Multinomial Logit Model. Regarding purchasing process, preceding studies have been conducted which employ disaggregate data analysis. Moore and Jovanis (1988) and Takita et al. (1993) analyzed the relationship between telecommunications and transportation in commercial transport. Matsumoto et al. (1988) and Takita et al. (1993) applied a Multinomial or a Nested Multinomial Logitmodel to analyze the purchasing behavior of consumers and the derived demand.

We also focus on the differences in consumer behavioral patterns between a major city (Tokyo) and a smaller regional city (Nagasaki).

## 2. Data Collection

We conducted a questionnaire survey in the two cities of Tokyo (the capital of Japan) and Nagasaki (a city located in southeastern Japan). The respondents comprised 1st and 2nd year students

of Waseda University (Shinjuku, Tokyo) and Nagasaki University (Nagasaki City), and was conducted in a lecture-style format.

The outline of the survey is as follows:

Period: April 21 – May 19, 2003

Method: Respondents were asked to fill out a questionnaire in the classroom.

Number of valid responses collected: 432 (45%)

We had conducted three preliminary surveys from January to April 2003, and those results were used to design the questionnaire sheet for the main survey. The final questionnaire consisted of two parts; Individual Attributes and Purchasing Simulation, as shown in Table 2. In the 'Individual Attributes' section, the respondents were asked about their age, gender, disposable income and other questions. Because the respondents were college students, their disposable incomes consisted of spending allowances and remittances from their parents, or wages from part-time jobs. In the 'Purchasing Simulation' section, we created 16 purchasing process sheets combining three modes, four goods, and four prices with using an orthogonal array<sup>[7]</sup>. For each respondent, we distributed one of these 16 sheets.

The following is an explanation of the basic statistical information acquired from the respondents (detailed statistics are presented in the Appendix). As to valid responses obtained from the questionnaire sites, 43% of the total were from Tokyo and the other 57% from Nagasaki. The respondents consisted of 284 males and 148 females; 66% male and 34% female. This distribution was due to the fact that the respondents mainly belong to the commerce studies department and the science and engineering department where male students are predominant. Their average age was 19.3, and the median was 18. The average commuting time to university was 48 minutes (median: 42 minutes), and the average commuting cost using public transportation was ¥318 (median: ¥233).

As for the respondents' Internet-use and purchasing activities, 89% of the respondents use the Internet via PCs or mobile phones, or both. Their average Internet-related experience is 33 months (2 years and 9 months), and the median is 36 months (this includes their Internet experience via mobile phones). Among Internet users, 26% of the respondents mainly use analogue lines and Integrated Service Digital Network (ISDN) lines to connect their PCs to the Internet. On the other hand, 63% of the respondents have already subscribed for "Broad-Band" services such as ADSL or fiber optic

networks. The respondents' daily average browsing time is 30.3 minutes (median: 21 minutes). 17.1% of the respondents do not use the Internet on a daily basis, while 23% use the Internet more than 40 minutes every day.

The respondents were asked about their experience of purchasing goods priced more than ¥5,000 during the past one year (from May 2002 to March 2003). 19% of the respondents said they had purchased items from Internet shops, 21% said they had made purchases from catalog-order shops, and 75% said they had bought items at retail shops. About 25% of the respondents said they did not purchase any goods priced more than ¥5,000 at retail shops; this was due to their young age and the fact that many respondents were high-school students during the previous year. .

### 3. Analysis of 'Willingness-to-pay for Merchandise Information' in the Information Gathering Stage

In this section, we analyze 'willingness-to-pay for merchandise information.' Before consumers decide to purchase goods, they need to gather appropriate information about the products. We applied the Tobit Model to inquire how individual attributes and purchasing modes affect consumers' 'willingness-to-pay for merchandise information.'

#### 3.1. Attributes Researched and Analytical Methods.

In our questionnaire survey, only 20% of respondents stated that they had a desire to pay for information when purchasing goods (Figure 1). The average price that the students were willing to pay for information was ¥668, while the average amount they were willing to pay for shipping charges for goods was ¥873. Figure 2 shows a distribution of the respondents' willingness-to-pay, classified by prices in the purchasing simulation.

In order to inquire about the factors that affect willingness-to-pay for information when purchasing goods, we extracted several individual attributes and question items from our purchasing simulation in the questionnaires [8]. These are shown in Table 3. We considered these attributes as independent variables, and respondents' willingness-to-pay as a dependent variable. Among the independent variables, transportation costs for commuting, Internet-related experience, and price of purchased goods were assumed as continual variables, and other variables such as location (Tokyo or Nagasaki) were changed to dummy variables. For example, for location, 0 represented that a respondent was from Nagasaki, and 1 that he/she was from Tokyo.

We employed a Tobit Model (Censored Regression Model) for our analytical purpose, evaluated the discrete choice whether a respondent intended to pay for information or not, and, in cases where they intended to pay, estimated the monetary sum. In the Tobit Model, the probability distribution consists of the normal distribution truncated in 0, and the discrete choice model of 0 and non-0.

We defined the respondents' willingness-to-pay for merchandise information  $y$  as follows:

$$y = \begin{cases} 0 & \text{if } \eta < 0 \\ \eta & \text{if } \eta \geq 0 \end{cases}$$

$y$  : Respondents' willingness-to-pay for merchandise information

$\eta$  : Latent variable

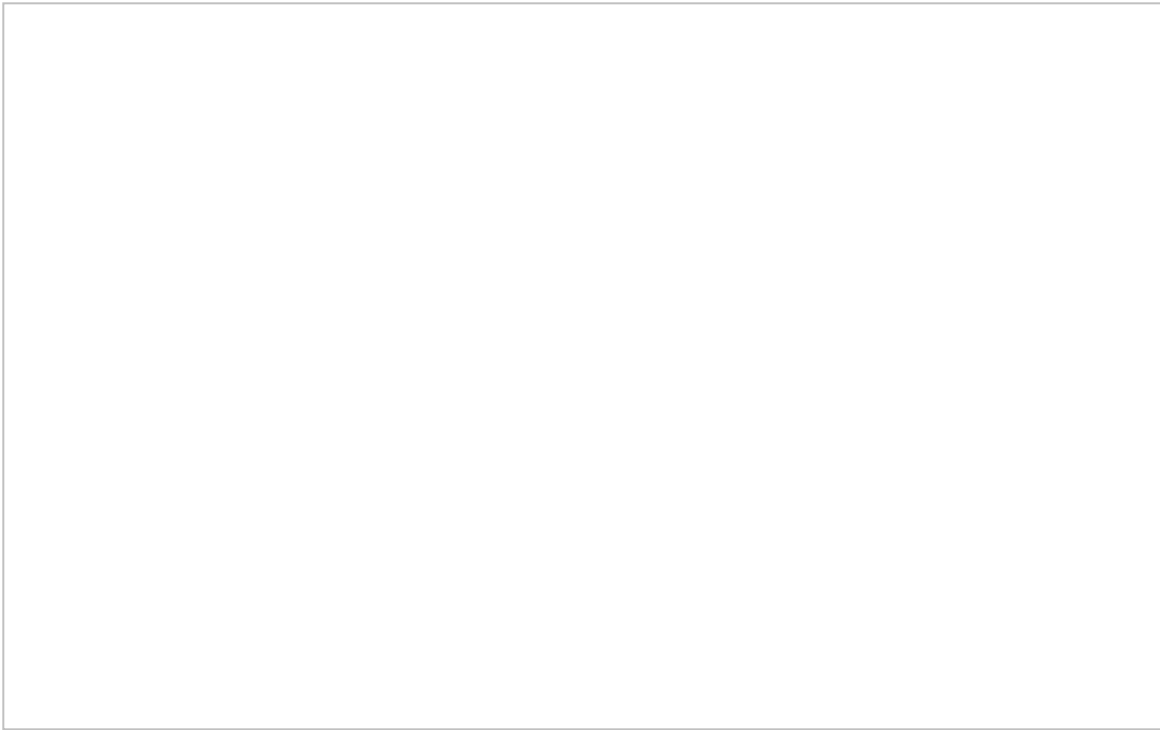
$x$  : Attribute vectors of choice  $\beta$

$\alpha$  : Weights of attribute vectors

$\epsilon$  : Error term



The log-likelihood function of this model is as follows:



### 3.2. Results of the Tobit Estimation

The results from the Tobit estimation are shown in Table 4. We set the null hypothesis as all weights equal 0, and the alternative hypothesis as, at least one weight is a non-0 value. The likelihood ratio of this estimation is -186.41, and the threshold of the  $\chi$ -square distribution (significant level: 1%, degree of freedom: 9) is 2.09. Then, the null hypothesis was rejected.

Among the attributes with a significant level of more than 10%, those which positively affect willingness-to-pay (WTP) for merchandise information were “Internet-related experience,” “use of Broad-Band line (fixed charge),” “window-shopping habits via the Internet,” and “belief that the Internet shortens the information gathering process” in the individual attributes, and “WTP for shipping charges” in the purchasing simulation items. Indexes representing experience and familiarity with the Internet (such as “Internet-related experience” and “information gathering habits via the Internet”) and the index regarding enhanced Internet environment like “use of Broad-Band line (fixed charge)” increased the WTP for merchandise information. “Window-shopping habits via the Internet,” and “belief that the Internet shortens the information gathering process” had negative coefficients, but according to our scale system (1 = Definitely yes; 5 = Not at all), they have positive impacts on WTP for merchandise information. Respondents who showed positive “WTP for shipping costs” were also likely to show positive “WTP for merchandise information.”

Meanwhile, among the attributes with a significant level of more than 10%, those which negatively affect WTP for merchandise information were “location” (Tokyo or Nagasaki) and “information gathering habits via the Internet” in the individual attributes, and there were none among the purchasing simulation items. For “location,” compared to the respondents in Tokyo, Nagasaki respondents significantly showed a higher WTP. “Information gathering habits via the Internet,” according to our scale, was negative, and this may mean that the more people use the Internet, the lower their WTP for merchandise information becomes. There was no purchasing simulation item that showed a significantly negative effect.

Among the individual attributes, “public transportation costs for commuting,” “degree of trusting Internet information,” and “degree of considering Internet information useful” were not significant in this estimation. As to usage of Internet lines, only “use of Broad-Band line (fixed charge)” was significant. During the process of independent variable selection, attributes such as “gender,”

“disposable income,” “commuting time,” and “experience with using Internet, catalog-order, and retail shops” were excluded as insignificant variables. Among the purchasing simulation items, differences among purchasing modes, goods, and prices were not considered as significant.

#### **4. Analysis of Purchasing Mode Selection**

In this section, we analyze the purchasing mode selection process and consider which individual attributes and purchasing simulation items affect their mode selections. We employed a Multinomial Logit Model to estimate the factors used in choosing retail, catalog-order, or Internet shops. Because the respondents mainly comprised 18-20 year-old college students, and they lacked adequate experience in purchasing via catalog-order and Internet shops, our questionnaire survey mainly relied upon SP data and a virtual purchasing process using simulated items.

##### **4.1. Attributes Researched and Analytical Methods**

In this analysis, the dependent variable is derived from the question which asks about purchasing modes when respondents purchase specific goods (books, tickets, digital contents, and PC equipment) in a simulated setting. For example, individuals who were given an “Internet shopping simulation,” sheet were asked to make one of following three choices, “would like to use only this method,” “would like to use catalog-order shops,” or “would like to use retail shops.” In this example, we considered the choice of “would like to use only this method” as meaning “would like to use Internet shops,” and resolved the

mode selection question set as a dependent variable. Figure 5 shows the independent variables which we used in this analysis<sup>[9]</sup>. In the individual attributes, we used individual basic attributes, commuting attributes, Internet-related attributes, and shopping attributes. In the purchasing simulation items, we used the purchasing modes, goods and prices listed in the distributed sheets, and “emphasis point in making purchase,” “WTP for merchandise information” and “WIT for shipping charges.”

Using Multinomial Logit Model estimation, the utilities of the respondents for three purchasing modes, (1) retail shop, (2) Internet shop, and (3) catalog-order shop, were estimated with the dependent variables.

When an individual  $i$  chooses alternative  $j$  among the three purchasing modes, the Multinomial LogitModel defines the utility of individual  $i$  as follows:

$U_{ij}$

$i$  : Purchasing modes (1:retail shop, 2:Internet shop, 3:catalog-order shop)

$U_{ij}$  : Utility of individual  $i$  when he/she chooses mode  $j$

$\beta_i$  : Vectors of simulation items in  $i$ 's questionnaire, and individual  $i$ 's attributes

$\alpha_j$  : Weights of each vector

$\epsilon_i$  : Error term

We considered that the error term was independently and identically distributed in Weibull distribution, and then, the probability of individual  $i$  choosing mode  $j$  from among the three purchasing modes  $\{1, 2, 3\}$  was represented as follows:

$$P_{ij} = \frac{\alpha_j \beta_i^{\alpha_j}}{\sum_{k=1}^3 \alpha_k \beta_i^{\alpha_k} + 1} \quad \text{where } \alpha_j > 0, \beta_i > 0.$$

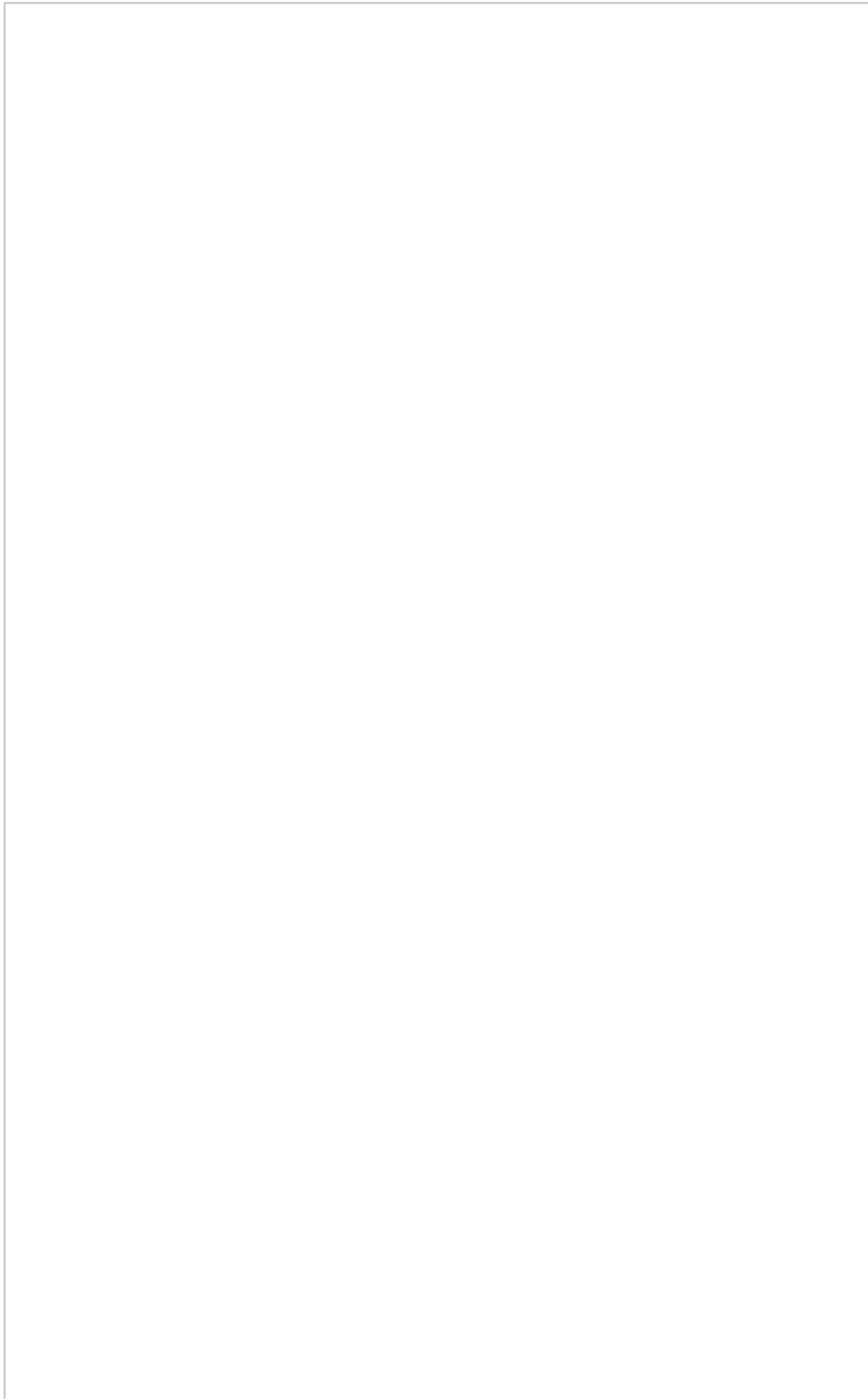
## 4.2. Results of Multinomial Logit Estimation

**Table 6: Indexes for the Fitness of the Model**

Index	Value
Likelihood Ratio	-101.556
Chi-square	22.16
Forecast Ratio	80%

Table 6 shows the indexes for the fitness of the model with maximum likelihood estimation. We set the null hypothesis as all weights equal 0, and the alternative hypothesis as, at least one weight is a non-0 value. The likelihood ratio of this estimation is -101.556, and the threshold of the  $\chi$ -square distribution (significant level: 1%, degree of freedom: 40) is 22.16. Then, the null hypothesis was rejected. The forecast ratio of the model is 80%. Figure 7 shows the factors which affect selection of "catalog-order shops" and "Internet shops" as opposed to "retail shops."





First, we examined the factors for Internet shopping. The factors that were significant and positive were “Internet-related experience,” “use of fiber optic network” and “innovativeness” in the individual attributes, and “emphasis on easiness of purchase” in the purchasing simulation items. Like WTP for merchandise information, “Internet-related experience” positively affects selection of Internet shops. “Use of fiber optic network” also has a positive effect because such networks comprise high-quality broad-band service in Japan with a fixed charge. “Innovativeness” is a factor which represents whether or not a respondent is likely to adopt new goods/merchandise or services. It is natural that this has a negative coefficient, and a positive impact on WTP in our scale system. It is interesting that “emphasis on easiness of purchase” has a positive effect on the use of Internet shops.

Meanwhile, the factors that were significant and negative included “use of wireless connection,” and “use of cable TV line” in the individual attributes, and “use of Internet shops” in the purchasing simulation items. The reason why “use of wireless connection,” and “use of cable TV line” negatively affects the use of Internet shops remains unclear in the scope of this research.

“Use of telephone line (fixed and non-fixed charges)” was not significant, and we extracted and excluded other attributes such as “location,” and “time and costs for commuting,” from the independent variables because they were not significant at all. Goods and prices in the purchasing simulation items, as well as WTP for merchandise information and shipping charges were also not significant in this estimation.

Second, we examined the factors for catalog-order shopping. The factors that were significant and positive included “emphasis on easiness of purchase” and “WTP for merchandise information” in the purchasing simulation items. For catalog-order shopping it is natural that “WTP for shipping charges” has a positive influence, but it is interesting to note that “WTP for merchandise information” also has a positive effect. Similar as for Internet shopping, respondents who value ease of purchase prefer to use catalog-order shops.

The only factor which was both significant and negative was “use of telephone line (non-fixed charge).” No interpretation was made concerning the relationship between using a telephone line to access the Internet and preferring catalog-order shopping. Other individual attributes and purchasing simulation items were either insignificant or were dropped during independent variable selection due to their insignificance.

Ultimately, a common significant attribute in both Internet shopping and catalog-order shopping was “emphasis on easiness of purchase,” and this factor positively affects both modes

## 5. Conclusion

In this paper, we studied consumer-purchasing activities in order to examine the derived transportation demand. To do so, we broke down the consumer purchasing behavior into two steps: an information gathering stage and a purchasing mode selection stage. In the information gathering stage, we focused on WTP (willingness-to-pay) for merchandise information, and examined individual and situational factors which affect the respondent’s decision making. Meanwhile, in the purchasing mode selection stage, the respondents’ choice between retail shops, Internet shops, and catalog-order shops was examined using a purchasing simulation.

In the information gathering stage, individual attributes related to Internet experience/usage environment affect WTP for merchandise information. These results are consistent with those obtained in previous research (Someya et al., 2003). In the purchasing mode selection stage, it is shown that individual Internet experience and usage environment only positively affect Internet shopping, and not catalog-order shopping. On the other hand, respondents who value ease of shopping activities select Internet shops and catalog-order shops rather than retail shops. Prior to this research it was assumed that retail shopping was easier than the other modes, and this is therefore a new finding. However, further detailed analysis is required to formulate a more concrete conclusion as to whether these relatively new shopping modes (Internet shopping and catalog-order shopping) are welcome as lighter modes than retail shopping, which involves transportation demands. The data utilized in this research was compiled using only responses from university students and our results therefore cannot be generalized. However, the results we obtained in both the information gathering stage and the purchasing mode selection stage are quite coherent with preceding researches.

As to the differences seen between a large city and a smaller regional city, it is interesting that only the information gathering stage was significantly affected, and not the purchasing mode selection stage. In empirical studies that examine the relationship between telecommunications and transportation, comparative analysis which focuses on spatial locations – such as large/small cities

and urban/suburban areas – will become important because the roles of telecommunications and transportation are assumed to vary greatly from region to region. Indeed, we were unable to find significant factors related to transportation and commuting in this survey, which are required in order to consider the direct relationships between telecommunications and transport.

## References

Electronic Commerce Promotion Council of Japan, **Market Survey of E-commerce of Businesses to Consumers (B to C) in Japan**, 2002, (in Japanese).

Greene, W. H., **Econometric Analysis** 3<sup>rd</sup> Eds., Prentice Hall, 1997.

Hitoshi Mitomo, and Toshiya Jitsuzumi, **Impact of Telecommuting on Mass Transit Congestion: the Tokyo Case**, Telecommunications Policy, vol.23, 1999.

Noel, K. C., The attribute structure of Internet shopping: What is important and what tradeoffs are possible between Internet, retail and catalog format?, Dissertation, Purdue University, 2001.

Kuriyama, K. "Conjoint Analysis", in Eiji Ohno ed., **Practice of Environmental Economic Evaluation**, Keiso, 2002, (in Japanese).

Moore, A. and Jovanis, P. P., "Modeling Media Choices in Business Organizations: Implications of Analyzing Telecommunications-Transpiration Interactions", **Transportation Research, A**, vol.22, no.4, pp.257-173, 1988.

NTT Data Institute of Management Consulting Inc. Electronic Commerce Promotion Council of Japan, Ministry of Economy, Trade and Industry, 'Market Survey of E-commerce in Japan', 2001, (in Japanese).

Sato, K., and Igarashi, H., A preposterior analysis of travel choice behaviors by an experimental planning models, **Transactions of the Japan Society of Civil Engineers**, vol.343, pp.151-158, 1984, (in Japanese).

Salomon, I., Telecommunication and travel (Substitution or Modified Mobility?), **Journal of Transport Economics and Policy**, pp.219-235, 1985.

Salomon, I., Telecommunications and the Death of Distance: Some Implications for Transport and Urban Areas, Urban Design, Telecommunication and Travel Forecasting Conference, August 1997.

Salmom, I. and Kopplman, F., A Framework for Studying Teleshopping versus Store Shopping, **Transportation Research, A**, vol.22, no.4, pp.247-255, 1988.

Salomon, I. and Schofer, J. L., Forecasting Telecommunications-Travel Interactions: The Transportation Manager's perspective, **Transportation Research, A**, vol.22, no.3, pp.219-229, 1988.

Someya, H., Otsuka, T., Jitsuzumi, T., and Mitomo, H., An empirical Analysis of the Impact of the E-commerce on Students' Purchasing Behavior, **Proceeding of the 19<sup>th</sup> Annual Meeting of the Japan Society of Information and Communication Research**, 2002, (in Japanese).

Takayuki M, Review and perspective of incorporating stated preference data in travel demand analysis, **Proceedings of Japan Society of Civil Engineers** vol 413/IV-12, 1990 (in Japanese).

Takita, T., Yuzawa, A., and Suda, H., Development on communications media choice model considering an interaction between transportation and telecommunication, **City planning review**.

Special issue, Papers on city planning, vol.28, pp.403-408, 1993, (in Japanese).

Tauber, E. M., Marketing Notes and Communications, **Journal of Marketing**, vol.36, pp.46-59, 1972.

The Council to Survey the Impact of Information Technology on Trip Demand, Report of the third meeting, 2000, (in Japanese).

The Ministry of Public Management, Home Affairs, Posts and Telecommunications, [2002 WHITE PAPER Information and Communications, 2002](#), (in Japanese).

Otsuka, T., Someya, H., Jitsuzumi, T., and Mitomo, H., the Impact of E-Commerce on Transportation Demand in Tokyo Area, **Handbook for The 4<sup>th</sup> International Regional Science Association International Conference**, p.21, 200.

Kutadume, K., Wakayama, K., and Miyamoto, K., A model of shopping behavior and the implication for the urban public transportation, **City planning review**, vol.33, pp.169-174, 1998, (in Japanese).

---

\* Ph.D. Student, Institute of Life Environmental Science, University of Tsukuba

\*\* Ph.D. Professor, Institute of Agricultural & Forest Engineering, University of Tsukuba

[1] La ZMG (zona metropolitana de Guadalajara) es conformada tradicionalmente por los municipios de Guadalajara, Tlaquepaque, Tonalá y Zapopan. Los municipios de El Salto y Tlajomulco son incorporados a partir de 1990. En todo caso Guadalajara o ciudad de Guadalajara se entenderá con referencia a la ZMG.

[2] El subsector manufacturero de bienes básicos está compuesto por las ramas de: alimentos, bebidas y tabaco; textil, vestido y cuero; vestido y otros artículos de punto; calzado, piel, papel e imprenta; industria de la madera, corcho y aserradero. El subsector de bienes intermedios por: las ramas de la química, resinas - hules, plásticos- y no metales; petroquímica y metales ferrosos; y metálicas básicas. Y por último el subsector de bienes de capital y duraderos es compuesto por la agregación de las ramas de la industria de productos metálicos, maquinaria y equipo, industrias de productos eléctricos y electrónicos; industria automotriz y otras.

[3] En cuanto a las actividades comerciales, C. Padilla (1997) provee con su estudio sobre la comercialización mayorista de frutas y legumbres un claro ejemplo de centralización de Guadalajara sobre la amplia región del occidente y del pacífico norte.

[4] Una estimación indirecta y aproximada de la cantidad de ocupados en el comercio informal se obtiene de la comparación entre los registros censales del sector comercio (Censos de Población vs Censos Económicos) La comparación para 1988/1990, suministra una diferencia de 62,667 ocupados de más en el censo de población y la de 1998/2000, otra de 114,862, que representan relativamente un 35.0% y un 36.5% respecto de la ocupación total en el comercio; es decir que considerando las diferencias entre los años del levantamiento de cada tipo de censos, se podría reconocer que al menos una tercera parte de la ocupación en el comercio se trata de integrantes informales, que a la vez, en su gran mayoría son trabajadores por cuenta propia.

[5] En otros términos se puede hablar de un proceso mediante el cual Guadalajara cambia su primacía tradicional (concentrador de recursos y de población) por una primacía funcional, de mayor centralización de funciones de gestión y de control económico. Este proceso es además de validez general y se observa en varios países de América Latina donde sobresalen las ciudades que se convierten en nodos de redes globales, por ejemplo, la Ciudad de México, São Paulo o Buenos Aires (De Mattos, 1998; Gilbert, 1998; Lo/Yeung, 1998; ver particularmente el caso de México en Parreiter, 2002: 385-440) Son pues las ciudades capitales a escala nacional donde se dan con mayor intensidad estas funciones, sin embargo, como se aprecia en este artículo, las ciudades de relevancia regional como Guadalajara también participan en un cambio en la naturaleza de su primacía.

[6] The Council to Survey the Impact of Information Technology on Transportation Demand, Report of the Third Meeting, 2000\_(in Japanese).

[7] We use SPSS Conjoint to generate an orthogonal design.

[8] As independent variables, we employed five questions which asked about respondents' attitudes towards merchandise information via the Internet in the individual attributes, and purchasing modes, goods and prices, which had already been allocated to the purchasing simulation in each questionnaire. We also used other questions in the questionnaire that were of a significant nature.

[9] As independent variables, we employed purchasing modes, goods and prices, which had already been allocated to the purchasing simulation in each questionnaire. We also used other questions in the questionnaire which were of a significant nature ( $P < 0.1$ ) in the individual attributes and in the purchasing simulation items. We also used five dummy variables related to respondents' current Internet lines, although some were not significant, because they were created from one single question.