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INSTITUTO TECNOLÓGICO Y DE ESTUDIOS SUPERIORES DE MONTERREY

CAMPUS CIUDAD DE MÉXICO



**NICARAGUA: STRUCTURAL ADJUSTMENT POLICY
ANALYSIS IN THE NINETIES**

**THE EFFECTS OF MERGERS, ACQUISITIONS AND JOINT VENTURES
BETWEEN US-MEXICAN FIRMS (1993-1994): AN EMPIRICAL ANALYSIS
USING THE EVENT STUDY METHODOLOGY**

THE KALMAN FILTER IN THE EVENT-STUDY METHODOLOGY

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Ph.D

ENERO 2002

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by

Gerardo Arturo Dubcovsky Rabinovich

Doctoral Research Report presented to the

**INSTITUTO TECNOLÓGICO Y DE ESTUDIOS
SUPERIORES DE MONTERREY**

In Partial Fulfillment of the Requirements for the Degree of

Ph.D

Campus Ciudad de México

Enero 2002

Hacemos constar que en la Ciudad de México, el día 28 de enero de 2002, el alumno:

Gerardo Arturo Isaac Dubcovsky Rabinovich

sustentó el examen oral en defensa de la Tesis titulada:

“Nicaragua: Structural adjustment policy analysis in the nineties”

“The effects of mergers, acquisitions and joint ventures between US-Mexican firms (1993-1994) an empirical analysis using the event study methodology”

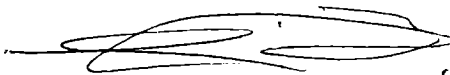
“The Kalman filter in the event-study methodology”

presentada como requisito final para la obtención del grado de:

Doctor en Administración

Ante la evidencia presentada en el trabajo de tesis y en este examen, el Comité Examinador, presidido por el Dr. Macario Schettino Yáñez, ha tomado la siguiente resolución:

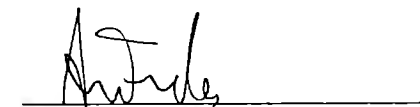
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AGRADECIMIENTOS

El agradecimiento es la memoria del corazón. Aliento y apoyo es lo que tuve en estos últimos ocho años: de Angelina, (esposa, amante, amiga y compañera), y de mis queridos hijos Pablo y Carlos, quienes me acompañaron y apoyaron en esta aventura por varios países. Mis padres, que siempre estuvieron con nosotros en las buenas, las malas y las peores; ellos me formaron y respetaron en el disenso, formando un espíritu crítico sin el cual es difícil navegar y descubrir. Finalmente mi Instituto, el Tec, donde encontré raíz y razón; con el afectuoso Pablo Buitrón creyendo en un extranjero recién llegado, dando el primer resoplido para zarpar; con Carlos Enrique y su calidez, alentando empecinadamente a llegar a destino... Muchas gracias a todos, son parte de mi memoria y corazón...

ABSTRACT

This research report consists in the three major papers I have worked on for the last six years. The first one, *Nicaragua: Structural Adjustment Policy Analysis in the Nineties*, presents three of the most relevant aspects of structural adjustment: exchange rate, tariffs and public spending reduction policies. They are evaluated with a Computable General Equilibrium (CGE) model, which is based on a Social Accounting Matrix built for 1991. The stabilizing and “outward” oriented development policies that we studied promote an improvement of the fiscal and foreign unbalances, but they do not guarantee a harmonious growth of the economy. Along with the need to promote, orient and regulate private and public investment, there is also a need for a body of microeconomic policies oriented to foster intersectoral linkages.

In *The Effects of Mergers, Acquisitions and Joint Ventures between US-Mexican Firms (1993-1994): An Empirical Analysis Using the Event Study Methodology*, we find that the Mexican firms involved in Joint Ventures have larger abnormal returns even more than previous studies. In addition, Mexican firm acquirers have positive and significant abnormal returns. Moreover divestitures of US companies generate a notable dollar wealth transfer to the Mexican acquirers. We detect an average of \$130 million dollars of wealth created in each pair of our sample. We can match these reactions on the efficiency theories of Mergers, i.e., investors’ perception that operating synergies and strategic realignment of firms will generate positive net present value. Finally the

cross-sectional analysis shows significant effects on abnormal return due to size of firms, country of origin and type of agreement but none due to Tobin's q . In the Mexican case the data shows a diagonal response to the corresponding news, which states the need for more specific methodology to complement and capture that phenomena.

The *The Kalman Filter in the Event-Study Methodology*, is a piece of research where we extend the methodology used in the previous paper into a richer and more dynamic environment by including time-varying parameters. Under the Bayesian framework, useful to update relevant information in a sequential learning mechanism, we use the Kalman filter to consider time dependent parameters, and we choose the initial distribution by using an information theory framework. The proposed extension leads to a more robust set-up in appraising the impact of economic and financial events on the market value of firms.

CHAPTER 1
NICARAGUA: STRUCTURAL ADJUSTMENT POLICY ANALYSIS
IN THE NINETIES ¹

Abstract

Three of the most relevant aspects of structural adjustment are presented in this paper: exchange policies, tariff policies, and fiscal policies. They are evaluated with a Computable General Equilibrium (CGE) model. The model is used first to assess the exchange rate as the most relevant macroeconomic variable both for inflation control and for the promotion of exports. Secondly, the CGE considers how trade liberalization sustained on Ricardian principles of comparative advantages within a framework of trade integration agreements. Finally, the CGE analyzes public expenditure contraction as a central element in the new role the state has in the economy. The model is based on a Social Accounting Matrix built for 1991, a key year for these transformations.

¹ Published in *The North American Journal of Economic and Finance* 10 (1999) 169-205.

Published: Chapter 6 in Antonio Yúñez-Naude, Raúl Hinojosa-Ojeda, compiladores *Cambio estructural y apertura comercial en América Central, en la República Dominicana y en Norteamérica: un enfoque de equilibrio general aplicado*. México: El Colegio de México, Centro de Estudios Económicos. (2000) p. 267-332

I. Introduction

The beginning of the nineties brought major changes in Nicaragua's economic structure, and even more in its citizens' perception of their country's future. The government encouraged reforms that affected structures built during the 1980s. The new vision of development incorporated an "outward integration" founded on a sustained growth of exports, a reduction in the state's participation in the economy, the promotion of the private sector as the main investor, the privatization of public companies, the dismantling of protectionism, and trade liberalization against a backdrop of price, monetary and fiscal stability, within a regional economic integration framework.

Three of the most relevant aspects of adjustment are presented in this paper: exchange policies, tariff policies, and fiscal policies. They are evaluated with a Computable General Equilibrium (CGE) model. The model is used first to assess the exchange rate as the most relevant macroeconomic variable both for inflation control and for the promotion of exports. Secondly, the CGE considers how trade liberalization sustained on Ricardian principles that make use of the comparative advantages within a framework of trade integration agreements. Finally, the CGE analyzes public expenditure contraction as a central element in the new role the state has in the economy. The model is based on a Social Accounting Matrix (SAM) built for 1991, a key year for these transformations.

We analyze the effects of devaluing the exchange rate by 5%, 10%, and 15% under different investment scenarios and different savings rates for the corporate sector, in the backdrop of fiscal discipline that characterized the behavior of public finances those years.

Then, we look into different tariff lowering scenarios analyzing the impact of 20%, 40%, 60%, 80% reduction, and a total import tax elimination.² Tariff liberalization is simulated under different scenarios of government income policies, with controlled exchange rates, foreign savings flows, corporate taxes and investment behavior. We achieve a very rich, if not exhaustive, panorama approached from different angles. Finally, the results of a 5%, 10%, 15%, 20%, and 25% reduction in public spending under differentiated investment and foreign balance scenarios are studied. In all simulations the effect on prices, production, and sectoral employment, trade, income distribution, and macroeconomic variables are considered. The paper consists of 5 parts. In Section 2 we will briefly describe the economic structure of Nicaragua and relevant aspects of adjustment policies. Section 3 briefly describes the SAM. Section 4 describes chief aspects of the Nicaraguan economic structure based on SAM data. Section 5 analyzes the simulations and their results. Finally, in Section 6 contain some conclusions.

²In Nicaragua, export tariffs are virtually non-existent.

II. Basic aspects of structural reforms

2.1. Before the 1980s

In 1951, five countries - Nicaragua, Guatemala, El Salvador, Honduras, and Costa Rica - constituted a Central American economic cooperation committee with the purpose of achieving political and economic integration in the region. This led in 1963, to creation of the Central American Common Market (CACM). At that time, Nicaragua was an essentially agricultural country exporting primary products, with an industrial sector amounting to only 15% of the Gross Domestic Product (GDP). An “import substitution” or “inward growth” strategy sought to develop a domestic industrial capacity and to affect the harmful effects of the deteriorating terms of trade in the post-war era. The most important strategies were inter-regional trade liberalization, a common foreign tariff and as incentives for integration industries under fixed exchange rates. A common tariff was applied on imports from third countries including specific tariffs as very high *ad valorem* rates for consumer goods and lower rates for intermediate and capital goods.³

Inter-regional trade rapidly grew. Exports for the region attained a peak of U.S. \$1.129 billion in 1980. Nicaraguan exports were the internal growth engine for the 1950 through

³In Nicaragua the non-weighted, *ad valorem* tariff was an average of 54.4%.

1978⁴ period. However, more than two thirds of the exports consisted of primary products. Besides, expansion led to a dual economy with a small, relatively modern, exporting sub-sector and a large traditional technologically obsolete agricultural sector. Nicaragua was a small country with a high degree of protectionism and a fixed exchange rate of 7 *Córdobas* for 1 dollar.

It can be argued that, at least for Nicaragua's case, the CACM as an industrializing process, failed. Final goods, previously imported, were now internally produced in assembly plants, whereas intermediate and capital goods were increasingly imported. This put pressure on the external account.⁵ We can say that instead of import substitution a change in import composition took place.⁶

2.2. *The 1980s*

⁴Their value rose from U.S.\$45 million in 1955 to around U.S.\$600 million by the end of the seventies.

⁵Imports reached U.S.\$700 million by the end of this period. The combination of the political crises of the early eighties along with low international prices for exportable goods, over-valued currencies and problems with foreign debt, led to imposition of trade barriers and bilateral agreements to replace the regional agreement. Hence, inter-regional exports plummeted to a little more than U.S.\$400 million in 1986.

⁶During the 1960s and the 1970s, Nicaraguan imports of consumer goods went from 38.3% of total imports to 24.9%, and their place was occupied by intermediate and capital goods imports.

During the 1980s, the *Sandinista* government radically changed the country's economic orientation. The state nationalized domestic trade, foreign trade, and the financial system and created state corporations that were "the people's property". As a result, state participation in the economy, by 1989, was 22.3% in the primary sector, 40.2% in the secondary sector, and 44% in the tertiary sector, contrasting with the 0%, 10%, and 42.7%, respectively in 1978. Agrarian reform involved a third of the land, it democratized property and fostered collectivization of agriculture. The strategy turned into an agroindustrial integration plan, with huge development projects sponsored by the government.

The manufacturing industry produced mainly for the local market and there was little capital investment. Credit was cheap and readily available. Therefore, corporations had a "soft budgetary restriction" (Kornai, 1979). However, the secondary sector of the economy lost competitiveness in responding to the internal demands of the armed conflict. Nicaraguan industry, under these circumstances and with obsolete equipment and strong restrictions on production, lost its marketing and technological edge. Thus, the economy emerged in the 1990s in crisis.

Taken together, armed conflict, the American trade and financial embargo and natural disasters prevented implementation of a development strategy. Hyperinflation occurred with acute fiscal and foreign unbalances. The fiscal deficit reached 28% of the GDP on the inside of a vicious inflation-devaluation-inflation circle.

2.3. *The 1990s*

In 1988, the *Sandinista* government began putting adjustment measures into effect. The administration of Violeta Chamorro after 1990 strengthened these. Hyperinflation⁷ stopped under the combined influences of a fixed exchange rate, monetary, and fiscal discipline. Foreign funds now financed the monetary and fiscal deficits; domestic credit contracted.

With hyperinflation controlled, the conditions were in place for the new growth strategy, a practice common to Central American countries: an “outward integration” process based on promoting exports, dismantling protectionism,⁸ opening trade, and reducing the state’s role in the economy. A simultaneous process of privatization of state corporations⁹, lowering of tariffs, trade liberalization and private investment promotion were started, all within a structure of price, monetary and fiscal stability and inside a framework of regional integration. A brief summary of the trade, tariff and fiscal policies follows.

2.3.1. *Trade policy*

⁷Inflation had surpassed 50% a month on the last year.

⁸The new “outward” development strategy dismantled the CACM protectionist system of the 1960s, reducing tariff dispersion as well as the greater protection enjoyed by final goods.

⁹In 1990 there were 351 state corporations. By the end of 1993, 270 had been privatized and 38 had been liquidated.

Export promotion requires real exchange rate depreciation. Through fixing the nominal exchange rate in 1991 was a decisive move that helped stop the price rise, it resulted in overvaluation that hindered export growth. Therefore, in January 1993 a policy of gradual depreciation of the exchange rate at a rate above the inflation rate was adopted. This real devaluation promoted the export drive between 1994 and 1996. To avoid the devaluation-inflation-devaluation vicious circle, structural fiscal adjustment, monetary and credit contraction and a measurable amount of foreign resources were required to support this process. Further, trade liberalization abolished export and import licensing and the requirement to sell foreign currency to the Bank Central. Finally, the trade discussions with Central America, Mexico, Peru, and Ecuador continued and Nicaragua joined the World Trade Organization (WTO) in 1995.

2.3.2. *Tariff policy*

In 1986, only *ad valorem* tariffs were left, reducing the nominal rate and in a range from 1% to less than 100%. A more significant change occurred in 1990, when the average nominal rate fell from 43.2% to 15.2% in 1991 to 14.8% in 1992. Against the backdrop of fixed exchange rates, the immediate impact was to increase imports, worsen the trade balance, and impact local production.

On March 1st., 1993, the Central American Tariff System (CATS) came into effect. This increased slightly the nominal rate to an average of 18.3%. Rate dispersion was lower than

in 1986, correcting a structure highly protectionist of final good industries. This process continued selectively during 1994 through 1996, when tariffs were eliminated on many raw materials and the maximum rate lowered for many products. The 1994 agreement with the IMF Enhanced Structural Adjustment Facility (ESAF) anticipated a tariff ceiling of 35% in 1996 and 32% in 1997.

2.3.3. Fiscal policy

State presence in the economy was drastically reduced. The privatization of state corporations reduced state employment by more than 65%, but contributed to rising unemployment from 11.1% in 1990 to 21.8% in 1993. If underemployment is included the rate went from 39.4% to 60% with 70% of the populations living in destitute conditions (ECLA, 1993).

The fiscal deficit was financed exclusively through foreign resources, though after 1995, domestic bonds (Tributary Bond Certificates) that financed up to 15% of this deficit were issued.

Along with the reduction of current expenses, fall in social expenditures¹⁰ and in public investment (that fell from 20% of the GDP during the eighties to 8% in the 1991 through

¹⁰Social expense has increased as a proportion of total expense. However, given the reduction of the latter, the expense on health per capita was reduced from U.S.\$25 in 1990

1993 period) took place. What public investment occurred was fully funded by foreign resources.

The ESAF agreement contemplates a greater promotion of public savings, a greater reduction in employment and service privatization.

Although it is too soon to evaluate the new “outwards oriented” strategy, there have been several positive signs. The real GDP, after a number of years with negative growth¹¹, expanded by more than an average 4% between 1994 through 1996. The value of exports increased by more than 40% in 1995 and 20.6% in 1996, including an upsurge in fishing, and nontraditional exports as well as in tourism. Forty percent of total exports were directed towards the U.S., 25% to the European Economic Community, and 25% to the Central America (destiny of nontraditional products). Though imports also grew (they represented 55.6% of the GDP in 1996), the trade deficit as a proportion of the GDP was reduced from 29.8% to 24.1% between 1991 and 1996.

Much of this growth, however, was sustained by foreign resources. Nicaragua between 1990 to 1994 was among the highest recipients of international aid. Excluding the payment of foreign debt service and the overdue amount owed to the World Bank and the Intern-

to U.S.\$12.5 in 1996, and education went from U.S.\$26 to U.S.\$23.5 in those years respectively (FIDEG, 1997).

¹¹The GDP decreased by an average of 0.2% between 1990 to 1993.

American Development Bank (IDB), the aid added up to \$2.64 billion USD (Avendaño, 1994). The problem is that with a decrease in this aid, further advance will depend on domestic economic policies. Hence the importance of analyzing these policies under different frameworks.

III. The SAM of 1991 (see Appendix 1)

The basic information for building the SAM for Nicaragua is the input-output matrix built by the *Secretaría de Planificación y Presupuesto de la República* (SPP) (Planning and Budget Office of the Republic), *Dirección de Cuentas Nacionales* (National Accounts Administration), 1986. Based on this matrix, the “MOCECA: *Modelo de coherencia económica del Istmo Centroamericano*” (Economic Coherence Model for the Central American Isthmus) (PFSA - CADESCA - CCE, Panama, 1992) was built. Afterwards, Patrick Dumazert updated the 1986 MOCECA to 1991 and called it “*Modèle MOCECA et Fenêtre Agricole*”, CADESCA-IRAM (1993). However, this latter paper has the disadvantage of not coinciding with the National Account totals reported by Nicaragua’s Banco Central. So, for the inside consistency of the matrix we took as reference the totals published in the Annual Report (*Informe Anual*), Banco Central de Nicaragua, years 1991 and 1992 (where the revised data for 1991 already appear), as well as the “*Indicadores de Actividad Económica*” (Economic Activity Indicators), Banco Central de Nicaragua (1993).

For foreign remittances, the source was “*Remesas y economía familiar en El Salvador, Guatemala y Nicaragua*” (Remittances and Household Economy in El Salvador, Guatemala, and Nicaragua), CEPAL (ECLA), LC/MEX/L.154, (1991).

Finally, the information on the Balance of Payments comes from the Banco Central. Information on Public Finances comes from the Finance Ministry and import tariff information came from Customs.

The Input-Output Matrix of 1986 had 73 sectors that are grouped into 12. There were two aggregation criteria. The first one takes into consideration foreign trade participation, as in the case of Agriculture for Exportation, Other Agricultural Products (that include nontraditional agricultural exports), Fishing, Agroindustry, Manufacturing Industries, Mining, and Other Services (that include tourism, transportation, and telecommunications). The second criterion was to aggregate sectors according to their importance in the GDP and in national economy. They are the cases of Basic Grains, Stock-Raising, Construction, Trade, and Government Services (basically, health and education).¹²

¹²It would have been interesting to keep some of the sectors from the Input-Output Matrix separate in the SAM. For example, Agroindustry (sector 6) from the SAM in Basic Agroindustry (sugar, etc.) and Other Agroindustries; Manufacturing (sector 7) in Consumer, Intermediate and Capital Goods Industries; Services from sector 11 in Education and Health and those from sector 12 in Transportation and Communications, Banks and Insurance, Water and Electricity, Housing, and Other Services. This would have resulted in a 20 sector matrix similar to the 1991 MOCECA. We would not work this way while building the SAM

The year 1991 was selected for the construction of the SAM. We decided not to select 1990 because it was a completely atypical year for the country and for the information, as we were told by the authorities of Nicaragua's Banco Central. To select 1991, we took into account the fact that we were at the beginning of a structural adjustment process. Besides, this year witnessed the re-establishment of relative prices, hyperinflation came to a halt due to a fixed exchange rate, the real reduction in import tariffs was implemented and the strongest contraction of public spending in all the adjustment period was carried out.

It is important to note that we did not obtain information that was more disaggregated than that published in the sources shown in Section 2.1, which is why the disaggregated figures were apportioned with the National Accounts totals.

From Public Finances, we obtained the disaggregation between Indirect Taxes: GVT (General Value Tax) and CST (Consumption Selective Tax).

Concerning import taxes, only the total is reported. We established the ITR (Import Tariff Rights) average rate for different sectors with Customs information. As for the GVT (General Value Tax) for imported products, the rates varied from 18.17% to 33.41% for industrial goods and to 53% for services, but these rates were reported, as was the

due to lack of information from National Accounts, so it was not possible to achieve the inner consistency of this matrix.

Consumption Selective Tax, within the GVT and CST totals for activities, that is, for already composite goods.

The division of households into high, intermediate and low follows MOCECA methodology, which also distinguishes them according to their sectoral (agricultural and stock raising, manufacturing, and services) participation. However, in the words of the authors themselves: “it is its weakest side because existing information to sustain it is very scarce and imprecise”. A chain of assumptions is made to estimate it, based on rural labor information. In the rural sector, high income households are the owners of large estates, the intermediate income households are the “rich” farmers, and the low income households belong to poor farmers, the semi-proletarian and the workers. For the urban-industrial sectors, high income households are those of big firm owners, intermediate income households are of small and medium-sized firm owners as well as those of company management, and low income households are made up by workers. Finally, in the service sector, high income households are the managers, intermediate income households are those of the self-employed and cooperativists, and low income households belong to wage-earners.

Regarding the foreign sector, it is very important to highlight the fact that, as in every year since 1990, the weight of donations is very high. For example, in 1991 the International Development Agency donated \$844 million, which equal more than half the GDP. However, most of that money was used to settle debts and previous engagements, so 891.7 million

córdobas (approximately \$180 million) were effectively included in the matrix, for this was what entered the government cash flow according to the Finance Ministry.

The data used to estimate remittances were the amounts provided by the ECLA, plus part of the mistakes and omissions from the balance of payments accounts (this was added because some officials from Nicaragua's Banco Central suggested it). Remittances were distributed according to the criteria of the surveys performed (MOCECA, 1991). Income due to foreign investment (equal to 50.5 million *córdobas*, according to balance of payments data) was attributed to high income households. Private donations of 64.4 million were attributed to corporations. Also, interest payments were included in the SAM. Finally, government transfers and company dividend distribution according to MOCECA 1991 criteria were also considered.

IV. Economic structure and social accounting matrix

Table 1 shows some data of the Nicaraguan economy taken from the SAM. The primary sector represents around 30% of the GDP and it contributes two thirds of total exports (including, sugar and meat which are in the agroindustrial sector). The Agriculture for Export and the Fishing sectors ship most of their production to foreign markets and show a positive balance of trade (The Other Agricultural Products had an exporting boom four years

later). Cattle-raising and Basic Grains sell most of their output domestically. One fourth of the basic grain supply is imported. The primary sector is the most important one for a new “outward” development strategy, though it has a pronounced dichotomy with a relatively modern exporting subsector and a traditional and technologically obsolete agriculture.

Table 1
Data on the social accounting matrix of Nicaragua

	Imp/Dom. Sales	Exp/Prod.	% GDP	Tariff/Imp	% Import	%Export	Exp-Imp
Agricultural exports	92.2%	75.3%	7.5%	8.0%	4.5%	33.4%	354.28
Basic grains	25.1%	0.0%	4.1%	6.5%	3.1%	0.0%	-117.51
Other agricultural products	47.8%	32.5%	1.1%	11.1%	1.4%	3.1%	-3.11
Fishing, forestry, & hunting	55.6%	78.0%	1.0%	8.0%	0.4%	5.7%	74.47
Stockbreeding	6.7%	0.0%	9.0%	7.6%	1.9%	0.0%	-71.97
Agroindustry	22.9%	17.0%	12.6%	7.7%	11.2%	20.3%	-105.50
Manufactures	161.5%	15.6%	17.4%	6.6%	58.7%	12.8%	-2021.41
Construction	24.4%	0.0%	2.2%	8.0%	1.9%	0.0%	-73.10
Mining	56.0%	64.9%	0.5%	11.4%	0.4%	2.9%	30.62
Trade	5.2%	0.0%	23.8%	8.0%	2.3%	0.0%	-88.08
Government services	18.1%	0.0%	10.9%	8.0%	6.0%	0.0%	-227.60
Other services	26.8%	23.2%	11.8%	6.6%	8.2%	21.9%	33.40
TOTAL	39.7%	15.1%	100.0%	7.0%	100.0%	100.0%	-2215.51

The industrial sector, only 20% of the GDP, is extremely dependent on capital good and raw material imports. Imported industrial final goods represent almost 40% of the total domestic supply. Two thirds of industry exports go to Central American countries. There is a deficit balance of trade. Only the mining sector has a positive balance, though it only represents 3% of exports and 0.5% of the GDP. The tertiary sector is 50% of the GDP: tourism, transportation and communications (in the Other Services sector) produce important positive balances.

The data in the SAM for Nicaragua show that there are limited links between the primary and industrial sectors (see Table 2). The primary sector buys only 15% of its intermediate inputs from agroindustry and 15% from manufacturing. On the other hand, agroindustry buys 35% of its intermediate inputs from the primary sector and the manufacturing industry buys less than 1% from that same sector. The only exceptions are agriculture for exportation (sugar) and cattle raising, which sell a good portion of their production to the agroindustry for processing before the products are sold domestically or outside the country.

Table 2
Primary and industrial sector links (SAM)

	Agric Export	Basic Grains	Other Agric	Fish.,Fores.,Hun t	Stockbreeding
Agroindustry	3.6%	1.5%	0.9%	0.8%	8.5%
Manufacture	3.3%	2.7%	2.0%	4.8%	2.4%

	Agroindustry	Manufacture
Agricultural exports	26.5%	0.0%
Basic grains	1.0%	0.0%
Other agricultural products	0.1%	0.0%
Fishing, forestry, & hunting	0.6%	0.5%
Stockbreeding	6.6%	0.0%

Imports tariffs are quite homogeneous with rates ranging from 6.5% and 11.4%. The average effective tariff is 7%.

Nicaragua has a pronounced dependency on external aid (see Table 3): 13% of household total incomes come from remittances¹³ and 31% of total government income comes from external donations (listed under the “other incomes” category).

Table 3
External support to income

Households	%	
	Remittances	Rem/Income
High	6.3%	2.5%
Middle urban	59.0%	22.2%
Middle rural	3.1%	6.7%
Lower urban	28.4%	21.7%
Lower rural	3.1%	4.0%
TOTAL	100.0%	

Government income	%
	Remittances
IGV	28.4%
ISC	14.3%
Tariffs	9.4%
Direct imports	8.9%
Transfers	7.5%
Other income	31.5%
TOTAL	100.0%

Agriculture for exportation employs half of rural labor (Table 4). Cattle raising is another important source of rural employment. In the urban sector, more than 80% of workers are in the service area.

Table 4
Factor demands (SAM)

¹³Most remittances are received by urban households, partly because of the characteristics of the survey used for the SAM, which was the one held by ECLA (1991).

	Agric Exp	Basic Grains	Other Agric	Fish, Forest. Hunt	Stock- breeding	Agro- ind	Manuf	Constr	Mining	Trade	Gov. Serv	Other Servs
Employment	10.3%	1.7%	1.0%	0.8%	6.7%	4.1%	8.1%	2.6%	0.4%	21.2%	26.6%	16.4%
Urban	0.0%	0.0%	0.0%	0.0%	0.0%	5.2%	10.2%	3.2%	0.5%	26.7%	33.4%	20.7%
Rural	50.0%	8.4%	5.0%	3.9%	32.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Capital	7.6%	7.1%	2.0%	1.3%	13.7%	17.2%	13.7%	1.5%	0.6%	27.0%	0.0%	8.3%

The manufacturing sector provides more than half the tariff revenue, while agroindustry and manufacturing contributes three quarters of total indirect taxes (Table 5). The urban sectors and corporations are the most important source of direct taxes.

Table 5
Tariff Structure

	Agric Exp	Basic grains	Other Agric	Fish,for hunt	Stock- breeding	Agro- ind	Manuf	Constr	Mining	Trade	Gov. Serv	Other Servs
Tariff	5.1%	2.8%	2.1%	0.4%	2.1%	12.3%	55.1%	2.2%	0.6%	2.6%	6.8%	7.7%
Indirect tax	2.0%	3.4%	0.4%	0.7%	4.4%	35.8%	38.8%	2.2%	0.3%	2.5%	1.6%	7.9%

	Middle High	Middle urban	Lower rural	Lower urban	Lower rural	Firms
Direct tax	13.9%	51.2%	3.8%	7.6%	0.0%	23.5%

V. Simulations and results (see model in Appendix 2)

A number of simulations were carried out separately to evaluate the impact of the three different economic policies: devaluation of the *córdoba*, tariff liberalization, and public expenditure reduction. These policies were the core of the reforms implemented in the nineties. Separate simulations analyses allow us to better identify the effects - at times complementary, at times contradictory - of these policies on production, employment, trade, consumption and income distribution. For each case, different macroeconomic “closures” and magnitude of policy application were carried out.

5.1. Devaluation

Devaluation has a direct impact on import prices with 40% of domestic sales imports representing more than 50% of the GDP. Because 47% of fixed capital gross formation is made up of imports, two exercises were carried out: in the first, aggregate investment is fixed and corporate savings are allowed to vary, whereas in the second one, investment is endogenous and the corporate savings rate is fixed. In both, foreign savings and government income are endogenous, but public spending is fixed to represent more accurately the fiscal effort the government made during the 1990s.

A currency devaluation in any of the closures brings forth a large reduction in foreign savings inflows and a substantial improvement in the external balance. When aggregate investment is

fixed, a significant increase in private savings must take place with the endogenization of its savings rate, while in the second exercise with free investment, this rate must be adjusted. Therefore, we have falls in consumption in the first case and in investment in the second, with reductions in the real GDP in both cases.

In the following section, the results of devaluing the *córdoba* by 5%, 10%, and 15% under both investment “closures” are discussed.

5.1.1. Fixed investment

5.1.1.a. Prices. Devaluation causes the consumer price index to increase (by 1% when the *córdoba* suffers a 5% devaluation and by 2.5% with a 15% devaluation), whereas the GDP price index increases by 0.24% with a 15% devaluation. For factors, only rural labor benefits from this policy favoring the agroexporting sectors. Capital returns are visibly lower. To a lesser degree, urban labor and land payments also drop. As we will see below, this is directly related to shifts in production and sectoral employment.

Table 6
Impact on prices (Base year percentage change)

DEVALUACION	5%	10%	15%
GDP deflator	-0.13	-0.05	0.24
Consumer price index	0.87	1.86	2.48
Producer price index	0.00	0.00	0.00
<i>Factor payments</i>			
Rural labor	3.30	6.62	9.97
Urban labor	-0.15	-0.21	-0.17
Capital (urban & rural)	-1.49	-2.91	-4.24
Land	-0.22	-0.51	-0.90
Exchange rate	5.00	10.00	15.00

5.1.1.b. Production, employment, and trade. Price behavior is partly explained by the GDP contraction in real terms (of - 0.44% to - 1.76%). The effects of a devaluation are radically different for each sector. Sectors, oriented towards foreign markets - such as agriculture for exportation (that employs half the rural labor), fishing and mining - grow notably, as do other services with a positive balance of trade. However, the decrease in consumption brings about a strong contraction of the primary sectors selling domestically (the cases of basic grains and cattle production sectors whose supply decreases by up to 4.3% and 8.3%, respectively). This causes a decline in the primary sector as a whole that can reach up to 0.6%. Also, the manufacturing sector, which depends heavily on imports, suffers a fall of almost 5%. Construction decreases due to the rise in import costs; trade falls because of the contraction in consumption and in the GDP. Therefore, the secondary sector is most affected by its dependency on imports.

Table 7
Impact on production (real GDP) (Base year percentage change)

Devaluation	Production		
	5%	10%	15%
<i>Aggregate GDP</i>			
Total GDP	-0.44	-1.03	-1.76
Primary GDP	-0.11	-0.32	-0.63
Secondary GDP	-1.07	-2.13	-3.19
Tertiary GDP	0.51	1.00	1.47
<i>Sectorial GDP</i>			
Agricultural exports	3.39	6.57	9.56
Basic grains	-1.35	-2.78	-4.30
Other agricultural	0.08	0.16	0.21
Forestry, hunting, & fishing	2.22	4.27	6.18
Livestock	-2.73	-5.48	-8.29
Agroindustry	-0.57	-1.14	-1.73
Manufactures	-1.67	-3.32	-4.94
Construction	-0.56	-1.14	-1.72
Mining	2.05	4.20	6.42
Trade	-0.26	-0.57	-0.93
Government services	1.13	2.19	3.18
Other services	1.28	2.64	4.10

The situation of the agroalimentary industry deserves special attention, since a devaluation causes a strong increase in its exports. However, domestic consumption is simultaneously depressed, so much so that the final result is a contraction (which grows as devaluation rises) in the agroalimentary sector. Changes in employment follow from the change in production. An increase in rural labor demand in the agroexporting sector more than offsets the drops in the basic grains and cattle raising sectors. However, the impact on urban labor is unfavorably reflecting changes in manufacturing, construction and trade. Devaluation causes a strong increase in total exports and in exports by sector (up to 15.6%) and it brings about a reduction in imports (of up to - 18.1% in total imports), reducing the external balance deficit

by half in the case of a 15% devaluation (from 443 to 220 million dollars). Adding in household remittances and government donations leads to a surplus in the current account.

Table 8
Impact on foreign trade (Base year percentage change)

Devaluation	5%	10%	15%
<i>Exports</i>			
Agricultural exports	4.32	8.39	12.24
Other agricultural	6.27	12.46	18.58
Forestry, hunting, & fishing	3.31	6.39	9.25
Agroindustry	7.36	14.82	22.38
Manufactures	1.10	2.09	2.97
Mining	3.38	6.80	10.25
Other Services	7.77	15.79	24.05
TOTAL	5.25	10.47	15.66
<i>Imports</i>			
Agricultural exports	-3.10	-5.96	-8.61
Basic grains	-14.48	-27.06	-38.01
Other agricultural	-11.39	-21.49	-30.49
Forestry, hunting, & fishing	-6.50	-12.34	-17.61
Livestock	-11.66	-22.00	-31.21
Agroindustry	-10.98	-20.77	-29.55
Manufactures	-5.41	-10.49	-15.28
Construction	-6.76	-12.77	-18.14
Mining	-4.31	-8.48	-12.52
Trade	-7.68	-14.51	-20.63
Government services	-5.56	-10.54	-15.02
Other services	-8.58	-16.31	-23.29
TOTAL	-6.76	-12.94	-18.61
Real trade balance*	-15.31	-29.59	-42.99

*The balance of the Trade Balance is -2215.8 millions of *cordobas* for the base year and -1876.6, -1560.1 and -1263.2 millions for the Devaluation experiment of 5%, 10%, and 15%, respectively

5.1.1.c. *Income distribution.* Income is redistributed to rural workers, with expanded agroexportation. Their shares increases by 2.2% with the maximum devaluation. The capitalist or urban professional sector sees its income share fall by 3.9%. Similarly, the rural

intermediate income sector (farmers focused on stock raising and basic grain activities) is visibly affected with their share falling up to 15% with the highest devaluation. Concerning the intermediate and lower urban households, their share in general income distribution increases but their incomes are reduced (though to a lesser degree than other kinds of households).

Table 9
Impact on income distribution

Devaluation	5%	10%	15%	
Base year percentage change				
Hogares				
High capitalist	-8.36	-16.84	-25.43	
Middle urban	-4.30	-8.66	-13.09	
Middle rural	-12.73	-25.68	-38.89	
Lower urban	-0.63	-1.24	-1.82	
Lower rural	0.93	1.85	2.75	
Devaluation	Base	5%	10%	15%
Participation in total income				
Households				
High capitalist	32.2	31.0	29.8	28.3
Middle urban	34.5	34.7	35.0	35.3
Middle rural	6.2	5.7	5.2	4.5
Lower urban	16.6	17.3	18.2	19.2
Lower rural	10.5	11.2	11.9	12.7

5.1.1.d. Other aggregate variables. We have already pointed out the large improvement in the foreign sector, with the current account turning from deficit into surplus when remittances and donations are considered. This brings an outflow of foreign savings (Table

10). Domestic source tax revenues, fall, particularly indirect taxes because of the contraction of the “fiscal industry” (liquor and tobacco industries).

Table 10
Results of other aggregate variables
(Base level in millions of Cordobas. Base year percentage change)

Devaluation	Base Level	5%	10%	15%
Government consumption	1483.9	0.00	0.00	0.00
Investment	1463.8	0.00	0.00	0.00
Private consumption	6675.2	-5.38	-10.61	-15.69
Family savings*	2.5	-646.51	-1303.88	-1972.61
Government savings	730.1	-2.74	-5.4	-8.02
Enterprise savings	150.2	241.92	489.6	743.29
Net foreign savings	581.0	-58.39	-112.86	-163.96
Remittances	800.9	0.00	0.00	0.00
Government income	2505.9	-0.16	-0.31	-0.45
Tariffs	267.0	-2.18	-4.38	-6.61
Indirect tax	804.0	-1.51	-2.94	-4.28
Households direct tax	192.2	-5.09	-10.25	-15.49
Enterprise direct tax	59.2	-1.49	-2.91	-4.24
Consumption tax	404.62	-4.55	-8.16	-11.83

Contraction of high and intermediate household incomes leading to lower direct and indirect taxes. There is a decrease in tariff incomes because of the reduction of imports. Only donations - fixed in dollars- experience a nominal increase due to the devaluation. Tax revenues in total drop slightly. With fixed public spending, this generates government dissavings that fluctuate between 2.7% and 8%. Finally, private consumption, the most affected macroeconomic variable, drops up to 15.7%.

5.1.2. Endogenous investment. When investment is endogenous devaluation produces a strong contraction (up to 86% with a maximum devaluation, Table 15) partly due to its high

imported content. It bears the burden of foreign sector adjustment. Policies behave as before (see Table 11). However, there are differences in factor incomes. Rural labor is favored since now there is a smaller reduction in the stock raising and basic grains sectors, notwithstanding the expansion in the agroexporting sectors.

Table 11
Impact on on prices (Base year percentage change)

Devaluation	5%	10%	15%
GDP deflator	0.08	0.59	1.72
Consumer price index	0.77	1.68	2.55
Producer price index	0.00	0.00	0.00
<i>Factor payments</i>			
Rural labor	4.82	9.62	14.37
Urban labor	-1.21	-2.12	-2.55
Capital (urban & rural)	-0.84	-1.52	-1.95
Land	3.17	6.30	9.41
Exchange rate	5.00	10.00	15.00

In general, factoral returns to land improve. Corporate savings are no longer the adjustment variable, therefore, capital returns are barely modified. The most serious impact is on urban workers due to the fall of investment and industrial activity. Real GDP contracts even more (Table 12) than in the previous case. The secondary sector is the most affected one (its declines range from 3.2% to 11.1%). In particular, the manufacturing and construction sectors are most depressed. The behavior of the other sectors and of employment follows a pattern similar to that of the first closure, when investment is fixed.

Table 12
Impact on production (real GDP) (Base year percentage change)

Devaluation	5%	10%	15%
<i>Aggregate GDP</i>			
Total GDP	-0.63	-1.56	-2.83
Primary GDP	-0.04	-0.10	-0.19
Secondary GDP	-3.18	-6.84	-11.14
Tertiary GDP	1.52	2.99	4.29
<i>Sectoral GDP</i>			
Agricultural exports	1.66	3.17	4.53
Basic grains	-0.48	-0.92	-1.32
Other agricultural	0.51	0.99	1.46
Other services	-5.57	-10.55	-14.95
TOTAL	-8.27	-16.20	-23.82
Real trade balance*	-17.54	-34.44	-50.64
*The balance of the Trade Balance is -2215.8 millions of <i>cordobas</i> for the base year and -1827.2, -1452.8 and -1093.8 millions for the Devaluation experiment of 5%, 10%, and 15%, respectively.			

The depreciation of the *córdoba* when investment is flexible results in a smaller expansion of exports but a greater contraction of imports causing an even stronger effect on foreign savings than in the previous closure (Table 13). Devaluation with flexible investment results in less important redistributive effects (Table 14). There is a general increase in household income, except for upper level urban professionals. Rural workers improve their income share. For macro variables (Table 15), results show government savings falling less: the greatest fall is in indirect tax collection with a smaller decline in consumer and direct taxes.

Table 13
Impact on foreign trade (Base year percentage change)

Devaluation	5%	10%	15%
<i>Exports</i>			
Agricultural exports	2.40	4.66	6.79
Other agricultural	3.79	7.31	10.58
Forestry, hunting, & fishing	2.36	4.51	6.44
Agroindustry	5.80	11.42	16.68
Manufactures	0.40	0.26	-0.64
Mining	3.81	7.54	10.96
Other services	10.77	22.04	33.30
TOTAL	4.75	9.43	13.87
<i>Imports</i>			
Agricultural exports	-3.55	-7.14	-10.87
Basic grains	-7.44	-13.93	-19.49
Other agricultural	-5.72	-10.71	-15.05
Forestry, hunting, & fishing	-3.19	-6.02	-8.59
Livestock	-7.33	-13.89	-19.70
Agroindustry	-5.79	-10.86	-15.24
Manufacturas	-8.95	-17.93	-27.01
Manufactures	-36.60	-67.44	-91.82
Mining	-5.22	-10.64	-16.27
Trade	-8.15	-15.37	-21.74
Government services	-6.37	-11.93	-16.64
Other services	-5.57	-10.55	-14.95
TOTAL	-8.27	-16.20	-23.82
Real Trade Balance	-17.54	-34.44	-50.64

Finally, consumption falls less than in the previous closure (of -1.7% in the most extreme case). The decline in investment, the most affected variable, produces a decline in the real GDP greater than in the previous case. The results clearly a policy dilemma: how should real devaluations be used to stimulate exports as the growth engine and to improve the external balance? Fixed public expenditures accompanied by fixed aggregate investment (first closure) improves the foreign balance and redistributes income to lower income households, mostly rural ones, but it contracts the economy and brings a welfare loss. On

the other hand, shifting the weight of the devaluation to investment instead of to consumption (second closure) has harder effects on production and welfare, and softer ones on income distribution. An alternative for the government could be to tie real devaluations to a public investment stimulus to the economy. This, however, requires sustained foreign support to savings.

Table 14
Impacts on income distribution

Devaluation	5%	10%	15%	
Base year percentage change				
Households				
High capitalist	-0.39	-0.60	-0.49	
Middle urban	0.55	1.24	2.19	
Middle rural	0.23	0.59	1.13	
Lower urban	0.34	0.86	1.65	
Lower rural	4.13	8.27	12.40	
Devaluation	Base	5%	10%	15%
Participation in total income				
Households				
High capitalist	32.2	31.9	31.6	31.3
Middle urban	34.5	34.5	34.5	34.5
Middle rural	6.2	6.2	6.2	6.2
Lower urban	16.6	16.5	16.5	16.5
Lower rural	10.5	10.9	11.3	11.6

Table 15
Results of other aggregate variables
(Base level in millions of Cordobas. Base year percentage change.)

DEVALUACION	Base level	5%	10%	15%
Government consumption	1483.9	0.00	0.00	0.00
Investment	1463.8	-26.91	-55.55	-85.75
Private consumption	6675.2	-0.82	-1.40	-1.70
Family savings*	2.5	-128.57	-253.57	-371.83
Government savings	730.1	-1.43	-3.20	-5.45
Enterprise savings	150.2	-0.85	-1.52	-1.96
Net foreign savings	581.0	-66.88	-131.33	-193.12
Remittances	800.9	0.00	0.00	0.00
Government income	2505.9	-0.13	-0.30	-0.49
Tariffs	267.0	-3.64	-7.69	-12.13
Indirect tax	804.0	-3.06	-6.12	-9.11
Households direct tax	192.2	0.34	0.84	1.59
Enterprise direct tax	59.2	-0.84	-1.52	-1.94
Consumption tax	404.62	-1.95	-4.05	-6.28

5.2. *Tariff elimination*

Nicaragua's trade policy during the 1990s moved to growing liberalization, regional integration and efforts to negotiate free trade agreements in an active tariff deregulation framework. The Banco Central in particular abandoned its foreign trade and its international operations monopoly; 1991 is the key year in trade liberalization. The maximum combined tariff¹⁴ of 200% that prevailed in 1990 was reduced to 40%. that year tariffs became more homogeneous. Liberalization continued during the 1990s, though sectoral effects were not uniform.

¹⁴Nicaragua has a combination of Import Tariff Rights (ITR), Temporary Protection Tariffs (TPT), and Tax Stamps (TS).

Tariff collection in 1991 represented 3.6% of the GDP and 15.5% of tax revenues. Even though there still was tariff dispersion among sectors, this differential effect is not accounted for in the simulations. The effective tariff paid by sectors for the “mixture” of imports fluctuated between 6% and 11.5%.

A simulation liberalizing tariffs has two immediate and direct effects: reduced government revenues and lower prices for imported products. In trade liberalization simulations, two alternative macroeconomic closures were carried out for the foreign sector: in one, the exchange rate is allowed to fluctuate and foreign savings are fixed, in the other one, the exchange rate is fixed while foreign savings are allowed to vary. As in other simulations, public expenditure is exogenous or fixed.

5.2.1. Free exchange rate and fixed foreign savings

Liberalization ranges from 20% to zero tariff. the following discussion deals with the results of the simulation that considers total liberalization.

5.2.1.a. Prices. In either case, when government income is assumed fixed (GF) or when it is allowed to vary (GL), a slight deflation occurs: lower than 2% in the National Consumer Price Index (NCPI) and of 3.2% in the GDP deflator (Table 16). The exchange rate depreciates to balance the external account: by 3.3% in the GF case and by 2.6% in the GL

case. In the GL case, the devaluation necessary to equilibrate the trade balance is less because of the reduction in investment (see below) that has a high import content. There is a slight increase in factor prices; price increments linked with the agro are the most significant ones. Rural labor increases but urban labor is static in the GL case due to a deterioration - linked to the fall of investment - in the secondary sector (see following section).

Table 16
Impact on prices (Base year percentage change)

Tariff liberalization	Fixed government income					Liberalized government income				
	20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
GDP deflator	-0.62	-1.26	-1.90	-2.56	-3.23	-0.62	-1.24	-1.87	-2.52	-3.17
Consumer price index	-0.05	-0.62	-0.82	-1.22	-1.44	-0.32	-0.73	-1.05	-1.20	-1.67
Producer price index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Factor payments</i>										
Rural labor	0.55	1.11	1.68	2.26	2.86	0.49	0.98	1.49	2.00	2.51
Urban labor	0.08	0.16	0.24	0.33	0.42	0.00	0.02	0.03	0.05	0.06
Capital (urban & rural)	0.11	0.21	0.32	0.43	0.55	0.17	0.35	0.52	0.71	0.89
Land	0.11	0.23	0.34	0.46	0.57	0.32	0.64	0.96	1.28	1.61
Exchange rate	0.63	1.28	1.93	2.59	3.26	0.51	1.02	1.54	2.06	2.59

5.2.1.b. Production, employment, and trade. The GDP increases slightly in real terms: up to 0.11% and by 0.02% for GF and GL respectively (Table 17). Sectoral results diverge in both closures. In the GF case, the secondary sector has a slight expansion, especially in construction and manufacturing that use a great amount of imported input. The opposite happens with GL, where the drop in investment depresses the sector.

Table 17
Impact on production (real GDP). (Base year percentage change)

Tariff liberalization	Fixed government income					Liberalized government income				
	20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
<i>Aggregate GDP</i>										
Total GDP	0.02	0.04	0.07	0.09	0.11	0.01	0.01	0.01	0.02	0.02
Primary GDP	-0.01	-0.02	-0.03	-0.05	-0.07	0.04	0.08	0.12	0.16	0.20
Secondary GDP	0.05	0.09	0.14	0.18	0.22	-0.23	-0.47	-0.72	-0.97	-1.23
Tertiary GDP	-0.02	-0.03	-0.05	-0.06	-0.08	0.10	0.20	0.30	0.41	0.52
<i>Sectoral GDP</i>										
Agricultural exports	0.65	1.31	1.99	2.67	3.36	0.28	0.56	0.84	1.13	1.42
Basic grains	-0.48	-0.97	-1.47	-1.98	-2.5	-0.16	-0.32	-0.48	-0.65	-0.83
Other agricultural	-0.26	-0.53	-0.81	-1.09	-1.38	-0.14	-0.29	-0.45	-0.61	-0.78
Forestry, hunting, & fishing	0.93	1.88	2.84	3.81	4.81	0.66	1.32	1.99	2.66	3.34
Livestock	-0.41	-0.83	-1.26	-1.7	-2.15	-0.1	-0.21	-0.32	-0.44	-0.56
Agroindustry	-0.05	-0.11	-0.16	-0.22	-0.28	0.38	0.78	1.19	1.61	2.04
Manufactures	0.05	0.1	0.14	0.18	0.21	-0.41	-0.84	-1.28	-1.74	-2.22
Construction	0.34	0.69	1.03	1.38	1.73	-2.61	-5.3	-8.06	-10.9	-13.82
Mining	1.05	2.16	3.31	4.53	5.81	0.67	1.38	2.13	2.91	3.74
Trade	-0.11	-0.21	-0.32	-0.44	-0.56	0.01	-0.02	-0.03	-0.04	-0.05
Government services	-0.19	-0.38	-0.58	-0.78	-0.99	-0.21	-0.42	-0.63	-0.85	-1.08
Other services	0.3	0.62	0.95	1.29	1.65	0.57	1.17	1.78	2.41	3.07

What happens in the primary sectors differs. Under GF, export sectors expand due to the devaluation (by 3.5%), but domestic consumption (basic grain and stock-raising) contract (by 2.3%) following the fall in consumption. Since the latter sectors are larger than the export sector, the result is a small decline in primary sector GDP. The opposite occurs in the GL case. Finally, the tertiary sector contracts with GF and expands with GL (in this case the trade sector dictates the modifications). Employment follows production variations and factor redistribution responds partly to the Stolper-Samuelson theorem. Hence, the expansion of agroexporting oriented sectors, by using rural labor intensively, redistributes income to this factor and to land in general. Urban sectors benefit from the economy's expansion in general, but much less than rural sectors (Table 16). Achieving equilibrium in the external balance requires a real devaluation, with exports (primary and alimentary) growing more than

imports in percentile terms (Table 18) under both the GL and the GF cases. Imports grow in quantity, with the effects of a tariff outweighing the effects of devaluation.

Table 18
Impact on foreign trade (Base year percentage change)

Tariff liberalization	Fixed government income					Liberalized government income				
	20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
<i>Exports</i>										
Agricultural exports	1.37	2.75	4.15	5.56	6.99	0.9	1.8	2.71	3.62	4.54
Other agricultural	0.91	1.82	2.75	3.68	4.62	0.66	1.33	2	2.68	3.35
Forestry, hunting, & fishing	1.34	2.69	4.07	5.47	6.88	0.96	1.93	2.9	3.89	4.89
Agroindustry	1.01	2.05	3.10	4.18	5.27	1.26	2.55	3.88	5.24	6.65
Manufactures	0.28	0.56	0.84	1.12	1.40	-0.24	-0.49	-0.75	-1.04	-1.34
Mining	1.33	2.72	4.17	5.69	7.28	0.9	1.84	2.82	3.84	4.92
Other services	1.44	2.93	4.46	6.04	7.66	1.57	3.18	4.85	6.57	8.34
TOTAL	1.16	2.33	3.53	4.76	6.00	0.97	1.95	2.96	3.99	5.04
<i>Imports</i>										
Agricultural exports	1.50	3.02	4.57	6.16	7.78	1.81	3.67	5.55	7.48	9.45
Basic grains	0.66	1.32	2.00	2.68	3.37	1.61	3.27	4.98	6.75	8.58
Other agricultural	1.88	3.84	5.87	7.99	10.21	2.74	5.61	8.63	11.8	15.14
Forestry, hunting, & fishing	1.01	2.05	3.12	4.23	5.37	1.59	3.23	4.93	6.69	8.52
Livestock	0.83	1.68	2.55	3.43	4.34	1.48	3.01	4.58	6.21	7.9
Agroindustry	0.62	1.24	1.88	2.53	3.19	1.34	2.71	4.14	5.61	7.13
Manufactures	0.23	0.46	0.69	0.93	1.16	-0.16	-0.33	-0.51	-0.7	-0.91
Construction	1.34	2.71	4.13	5.60	7.12	-1.51	-3.12	-4.83	-6.66	-8.6
Mining	0.59	1.21	1.84	2.50	3.19	0.45	0.93	1.44	1.97	2.54
Trade	1.22	2.48	3.78	5.13	6.52	1.51	3.08	4.7	6.38	8.13
Government services	0.95	1.94	2.96	4.00	5.09	1.04	2.12	3.23	4.38	5.57
Other services	0.36	0.72	1.09	1.46	1.84	0.87	1.76	2.68	3.63	4.6
TOTAL	0.48	0.97	1.47	1.98	2.49	0.4	0.81	1.23	1.66	2.09
Real trade balance*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* The balance on the Trade Balance is of -2215.8 millions of *cordobas*.

5.2.1.c. Income distribution. In the GF case, corporate taxes rise, so the upper level urban professional sector sees its income fall. Rural workers are favored by the expansion of agroexporting, while the intermediate rural sectors (cattle farmers and basic grain producers) are the affected adversely (Table 19). Workers increase their total participation by 0.4%

whereas high level urban professionals and intermediate rural workers drop by 0.7% and 0.3%, respectively. With GL all sectors see their incomes grow, with slight changes in their total participations. Redistribution is therefore relatively neutral, but since total incomes rise, liberalization improves welfare.

Table 19
Impacts on distribution of income

Tariff liberalization	Fixed government income					Liberalized government income				
	20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
Base year percentage change										
Households										
High capitalist	-0.84	-1.70	-2.58	-3.49	-4.42	0.14	0.28	0.42	0.57	0.72
Middle urban	-0.40	-0.80	-1.22	-1.66	-2.10	0.18	0.36	0.55	0.74	0.93
Middle rural	-1.33	-2.69	-4.09	-5.53	-7.00	0.22	0.44	0.67	0.9	1.13
Lower urban	0.00	0.01	0.02	0.02	0.02	0.13	0.26	0.39	0.53	0.67
Lower rural	0.27	0.54	0.82	1.10	1.38	0.45	0.9	1.36	1.83	2.31
Participation in total income										
Households										
High capitalist	32.2	32.1	31.9	31.8	31.7	32.2	32.2	32.2	32.1	32.1
Middle urban	34.5	34.5	34.5	34.6	34.6	34.5	34.5	34.5	34.5	34.5
Middle rural	6.2	6.2	6.1	6.1	6.0	6.2	6.2	6.2	6.2	6.2
Lower urban	16.6	16.6	16.7	16.8	16.9	16.6	16.5	16.5	16.5	16.5
Lower rural	10.5	10.6	10.7	10.8	10.9	10.5	10.6	10.6	10.6	10.6

5.2.1.d. Other aggregate variables. With GF, the reduction in government income due to tariff liberalization is compensated through corporate taxes (remember that foreign savings are kept fixed). With zero tariffs these taxes would have to increase in the corporate tax burden (that translates into forced savings of the upper capitalist sector), consumption contracts (Table 20). The alternate closing (GL, where the reduction in government income cannot be compensated) is more interesting. If a modification in foreign aid to the government does not take place, the drop in total fiscal income is of 10.1%. Government dissavings lead to a fall in aggregate investment of 14.7%. To conclude, tariff liberalization

with a flexible exchange rate leads to an expansion of the economy and to redistributive effects which favor workers. If the government does not receive external aid, the reduction in tariffs leads to dissavings and, therefore, to reductions in investment.

Table 20
Results on other aggregate variables
(Base level in millions of Cordobas. Base year percentage change.)

Tariff liberalization	Base	Fixed government income					Liberalized government income				
		20%	40%	60%	80%	100%	20%	40%	60%	80%	100%
Government consumption	1483.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment	1463.8	0.16	0.32	0.48	0.63	0.79	-2.82	-5.70	-8.65	-11.66	-14.74
Private consumption	6675.2	-0.10	-0.21	-0.32	-0.44	-0.56	0.53	1.08	1.64	2.22	2.81
Family savings*	2.5	-73.42	148.64	225.71	-304.71	-385.69	-5.48	-11.02	-16.63	-22.30	-28.03
Government savings	730.1	0.44	0.89	1.35	1.82	2.29	-6.07	-12.27	-18.61	-25.08	-31.69
Enterprises savings	150.2	-1.82	-3.69	-5.60	-7.56	-9.58	0.17	0.35	0.52	0.71	0.89
Net foreign savings	581.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Remittances	800.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government income	2505.9	0.00	0.00	0.00	0.00	0.00	-1.94	-3.92	-5.94	-8.00	-10.10
Tariff	267.0	-19.08	-38.60	-58.58	-79.04	-100.00	-19.22	-38.82	-58.81	-79.20	-100.00
Indirect tax	804.0	0.03	0.06	0.09	0.12	0.14	-0.10	-0.21	-0.32	-0.44	-0.56
Households direct tax	192.21	-0.48	-0.98	-1.49	-2.01	-2.55	0.17	0.34	0.52	0.70	0.88
Enterprises direct tax	59.2	81.41	164.85	250.38	338.08	428.02	0.17	0.35	0.52	0.71	0.89
Consumption tax	404.62	-0.38	-0.76	-1.16	-1.57	-1.99	-0.20	-0.39	-0.60	-0.81	-1.02

5.2.2. Fixed exchange rate and endogenous foreign savings

The fundamental difference between this and the previous closing lies precisely in a government controlled exchange rate with variable foreign savings. The latter is the adjustment variable with tariff liberalization. It will no longer be necessary to adjust consumption or investment as in the previous closing, but foreign can substitute for

government savings. To isolate the effects of trade liberalization under this exchange rate regime, aggregate investment was fixed and tax revenues allowed to vary.¹⁵

5.2.2.a. Prices. The direct effect of tax reduction lowers import prices. The GDP deflator and the NCPI (Table 21) fall by 3.4% and 2.2%, respectively. Urban sectors benefit. Capital returns increase between 0.47% and 2.43% for the 20% and zero tariff scenarios. Urban labor shares improve between 0.26% and 1.33%, while rural labor suffers slightly damaged (its reduction reaches up to - 0.21%). These changes are directly related to the expansion of the secondary sector.

Table 21
Impact on prices (Base year percentage change)

Tariff liberalization	20%	40%	60%	80%	100%
GDP deflator	-0.65	-1.31	-1.93	-2.62	-3.41

¹⁵An alternate closure with endogenous investment leads to results that are very similar to those of this closure though different in magnitude. In fact, investment expansion only increases foreign savings requirements because of its high import content, but government dissavings remain practically unaltered.

Consumer price index	-0.31	-0.77	-1.12	-1.73	-2.16
Producer price index	0.00	0.00	0.00	0.00	0.00
<i>Factor payments</i>					
Rural labor	-0.04	-0.09	-0.13	-0.17	-0.21
Urban labor	0.26	0.53	0.79	1.06	1.33
Capital (urban & rural)	0.47	0.95	1.43	1.92	2.43
Land	0.14	0.28	0.42	0.56	0.71
Exchange rate	0.00	0.00	0.00	0.00	0.00

5.2.2.b. *Production, employment, and trade.* Real GDP increases by between 0.08% and 0.33% depending on the magnitude of the tariff cut (Table 22). At a sectoral level, secondary activities expand (up to 1.79%) whereas the rest contract slightly. All primary activities (with the exception of stock raising) have real declines, especially those export oriented. The increase in consumption favors those primary sectors producing for the domestic market, such as stock-raising and basic grains. Unexpectedly, however, the GDP of the latter sector drops in real terms up to 0.5%. The explanation is substitution of cheaper imported products. The difficulties of rice and sorghum producers since the 1980s, when they saw the market practically flooded by low priced imports, are well known. So, trade liberalization generates an increase of up to 12.5% in grain imports, obviously affecting the domestic sector.

Table 22
Impact on production (Real GDP) (Base year percentage change)

Tariff liberalization	20%	40%	60%	80%	100%
<i>Aggregate GDP</i>					

Total GDP	0.08	0.15	0.22	0.28	0.33
Primary GDP	-0.12	-0.24	-0.36	-0.49	-0.61
Secondary GDP	0.43	0.86	1.30	1.75	2.21
Tertiary GDP	-0.14	-0.28	-0.42	-0.57	-0.72
<i>Sectorial GDP</i>					
Agricultural exports	-0.41	-0.82	-1.24	-1.66	-2.09
Basic grains	-0.10	-0.19	-0.30	-0.40	-0.51
Other agricultural	-0.34	-0.68	-1.04	-1.41	-1.79
Forestry, hunting, & fishing	-0.05	-0.11	-0.16	-0.21	-0.27
Livestock	0.19	0.38	0.58	0.78	0.98
Agroindustry	0.31	0.62	0.94	1.27	1.61
Manufactures	0.38	0.78	1.18	1.58	2.00
Construction	0.27	0.54	0.81	1.08	1.34
Mining	0.39	0.80	1.22	1.64	2.08
Trade	0.01	0.02	0.03	0.03	0.04
Government services	-0.36	-0.72	-1.09	-1.47	-1.85
Other services	-0.10	-0.20	-0.31	-0.41	-0.53

Employment of rural labor is also adversely affected. The industrial sector turns benefits. Manufacturing, agroindustry, construction, and mining witness an expansion of their activities of up to 2%. Because employment expansion in these sectors compensates, by far, the drop in services, redistribution to urban labor increases and, for these same reasons, capitalists also benefit. Exports show a slight increase of up to 0.93%. Even though the nominal exchange rate is fixed, the drop in domestic prices brings about a real exchange rate devaluation favorable to exports (Table 23). Trade liberalization implies a strong import expansion (of 1.45% to 7.71% for a 20% reduction and zero tariff respectively). The balance of payments deficit grows from approximately 440 million dollars to almost 500 million dollars. Thus, an inflow of foreign resources is necessary.

Table 23
Impact on foreign trade (Base year percentage change)

Tariff liberalization	20%	40%	60%	80%	100%
<i>Exports</i>					
Agricultural exports	0.03	0.05	0.08	0.1	0.12
Other agricultural	-0.05	-0.09	-0.14	-0.19	-0.24
Forestry, hunting, & fishing	0.09	0.18	0.27	0.36	0.46
Agroindustry	0.58	1.18	1.79	2.42	3.06
Manufactures	0.33	0.67	1.01	1.36	1.72
Mining	0.42	0.85	1.29	1.75	2.21
Other services	-0.02	-0.05	-0.08	-0.11	-0.15
TOTAL	0.18	0.36	0.55	0.74	0.93
<i>Imports</i>					
Agricultural exports	2.43	4.92	7.46	10.06	12.72
Basic grains	2.64	5.37	8.21	11.16	14.22
Other agricultural	3.58	7.35	11.32	15.5	19.92
Forestry, hunting, & fishing	2.21	4.51	6.88	9.34	11.88
Livestock	2.4	4.89	7.47	10.16	12.96
Agroindustry	2.11	4.3	6.57	8.92	11.36
Manufactures	0.96	1.94	2.95	3.98	5.04
Construction	2.22	4.51	6.9	9.37	11.94
Mining	1.13	2.29	3.5	4.75	6.04
Trade	2.66	5.43	8.31	11.32	14.46
Government services	1.81	3.68	5.62	7.61	9.68
Other services	1.67	3.4	5.17	7	8.88
TOTAL	1.45	2.94	4.48	6.07	7.71
Real trade balance*	2.35	4.78	7.28	9.86	12.53

*The balance on the Trade Balance is of -2215.8 millions of *cordobas* for the base year and up to 2493.4 for the complete Open Market experiment

5.2.2.c. *Income distribution.* With a tariff reduction all sectors improve their incomes in real terms (up to 1.3% when liberalization is complete Table 24). However, the urban professional sector and their rural and urban intermediate sectors benefit most. Their income shares slightly increases (0.1%) whereas those of urban and rural workers decrease in similar proportion. In sum, notwithstanding the general improvement of income, liberalization under a fixed exchange rate favors capital over labor.

Table 24
Impacts on distribution of income

Tariff liberalization	20%	40%	60%	80%	100%
Base year percentage change					
Households					
High capitalist	0.35	0.70	1.06	1.42	1.79
Middle urban	0.25	0.50	0.75	1.00	1.26
Middle rural	0.38	0.77	1.16	1.56	1.97
Lower urban	0.19	0.38	0.57	0.76	0.95
Lower rural	0.02	0.04	0.07	0.10	0.13
Tariff liberalization	20%	40%	60%	80%	100%
Participation in total income					
Households					
High capitalist	32.2	32.2	32.3	32.3	32.3
Middle urban	34.5	34.5	34.5	34.5	34.5
Middle rural	6.2	6.2	6.3	6.3	6.3
Lower urban	16.6	16.5	16.5	16.5	16.5
Lower rural	10.5	10.5	10.5	10.5	10.4

5.2.2.d. *Other aggregate variables.* The fall in of government income produced by the reduction of tariffs is barely compensated by the increase in all tax collections (Table 25). Growth of manufacturing suggests larger revenues from the “fiscal industry”, and therefore indirect taxes grow up to 1.13%. Similarly, the improvement in household incomes (especially in the intermediate and upper urban levels) means more direct tax revenues.

Table 25
Results of other aggregate variables
(Base level in millionsof Cordobas. Base year percentage change)

Tariff liberalization	Base	20%	40%	60%	80%	100%
Government consumption	1483.9	0.00	0.00	0.00	0.00	0.00
Investment	1463.8	0.00	0.00	0.00	0.00	0.00
Private consumption	6675.2	0.8	1.52	2.31	3.11	3.93

Family savings*	2.5	15.66	31.55	47.69	64.07	80.70
Government savings	730.1	-5.89	-11.97	-18.25	-24.74	-31.46
Enterprise savings	150.2	0.47	0.95	1.43	1.92	2.43
Net foreign savings	581.0	8.98	18.23	27.78	37.62	47.78
Remittances	800.9	0.00	0.00	0.00	0.00	0.00
Government income	2505.9	-1.88	-3.83	-5.83	-7.90	-10.04
Tariff	267.0	-18.80	-38.17	-58.14	-78.74	-100.00
Indirect tax	804.0	0.22	0.44	0.66	0.89	1.13
Households direct tax	192.2	0.27	0.53	0.81	1.08	1.36
Enterprise direct tax	59.2	0.47	0.95	1.43	1.92	2.43
Consumption tax	404.62	0.10	0.21	0.32	0.43	0.55

However, this is insufficient to offset the loss in tariff income (which represents 15.5% of the government's tax income). As tariffs are reduced revenue loss ranges from 1.88% to 10% with zero tariffs. Since expenses are fixed, an even bigger current government deficit is produced and public savings drop to - 31.5% with complete liberalization. Because aggregate investment does not change and private sector income and consumption expand, the situation can only be sustained if there is a growing flow of foreign resources. Absent this, the exhaustion of reserves and pressure to increase imports would force devaluation. Our conclusions reflect what happened in Nicaragua during 1991 and 1992, when a controlled exchange rate and trade liberalization were combined. These measures generated a boom in private consumption (Banco Central, 1995) that forced a 20% devaluation of the *córdoba* for the following year (1993) and the implementation of a sliding nominal exchange rate to increase external competitiveness.

The results of the simulation with trade liberalization show that reduction or elimination of tariffs leads to an expansion of the economy and to palpable efficiency gains. On the other hand, sectoral and employment results depend on how the government responds to the

reduction of its income and on the behavior of the foreign sector. The redistributive effects rest

on how the authorities handle the exchange rate. If the exchange rate floats, redistribution favors workers while a fixed exchange rate favors the corporate sector (rural and urban). In both cases more foreign resources are necessary to support the trade liberalization process. Without foreign resources, investment drops under flexible exchange rates while under fixed rates the foreign deficit cannot be sustained.

5.3. Public expenditure contraction

We carried out two simulations. In both, tax revenues can vary and expenditures are cut (an increase in public savings). In the first simulation, foreign savings are endogenized: this is then the adjustment variable, so aggregate investment is fixed. This closing will allow us to analyze the situation of the early 1990s when investment remained almost constant as a proportion of the GDP. In the second closing, foreign savings are exogenous and aggregate investment can vary. In both cases the exchange rate is allowed to fluctuate and gradual reductions in expenditure are simulated (5%, 10%, 15%, 20%, and 25%).

5.3.1. Variable foreign savings and fixed investment

The reduction of public spending implies an increment in public savings. In order for the foreign sector to be the adjustment account - given that investment is exogenous -, a

currency depreciation in real terms is required to reduce the trade deficit. Consequently, the key effects take place within the urban tertiary sectors.

5.3.1.a. Prices. Devaluation is 7.12% with a 25% reduction in expenditure (Table 26). The increase in price indices is slight and less than the devaluation due in part to a fall in real GDP and reduced imports. The GDP deflator increases up to 0.46% and the NCPI up to 1.3%. Factoral redistribution strongly favors rural labor and land, whose shares grow up to 9.6% and 7%, respectively, because of the agroexporting sectors expansion. Public cuts affect urban labor the most. This sector's share falls by 7.5%. Finally, capital returns increase between 0.6% and 3% due to industrial expansion.

Table 26
Impact on prices
(Base year percentage change)

Cost reduction	5%	10%	15%	20%	25%
GDP deflator	-0.62	-1.26	-1.90	-2.56	-3.23
Consumer price index	0.21	0.70	0.77	0.99	1.26
Producer price index	0.00	0.00	0.00	0.00	0.00
<i>Factor payments</i>					
Rural labor	2.06	4.05	5.97	7.82	9.59
Urban labor	-1.63	-3.19	-4.69	-6.13	-7.51
Capital (urban & rural)	0.59	1.18	1.78	2.39	2.99
Land	1.51	2.97	4.38	5.74	7.05
Exchange rate	1.54	3.02	4.44	5.81	7.12

5.3.1.b. Production, employment, and trade. The real GDP slightly contracts, between 0.03% and 0.16% (see Table 27) due to the fall of the tertiary sector caused by the reduction in public spending. The primary sector expands globally between 0.27% and 1.11% due to the momentum of the agroexporting sectors from the currency depreciation. The growth of agroexporting, fishing, and other agricultural activities compensates by far the slight fall in

basic grains and in stock-raising supply (up to 0.7% and 1.7%, respectively). Because that employment follows these patterns, rural labor is the most favored. The secondary sector also expands, mostly the alimentary industry (by up to 2.6%) and mining (by up to 11.6%) since both are important exporters.

Table 27
Impact on production (real GDP) (Base year percentage change)

Cost reduction	5%	10%	15%	20%	25%
<i>Aggregate GDP</i>					
Total GDP	-0.03	-0.06	-0.09	-0.12	-0.16
Primary GDP	0.27	0.51	0.73	0.93	1.11
Secondary GDP	0.26	0.51	0.77	1.03	1.28
Tertiary GDP	-0.22	-0.45	-0.67	-0.89	-1.11
<i>Sectoral GDP</i>					
Agricultural exports	1.04	1.99	2.87	3.68	4.43
Basic grains	-0.15	-0.29	-0.43	-0.57	-0.71
Other agricultural	0.47	0.9	1.3	1.67	2
Forestry, hunting, & fishing	1.89	3.68	5.35	6.93	8.4
Livestock	-0.39	-0.76	-1.1	-1.43	-1.73
Agroindustry	0.55	1.09	1.6	2.1	2.58
Manufactures	0.01	0.03	0.06	0.1	0.14
Construction	-0.14	-0.28	-0.41	-0.53	-0.64
Mining	2.09	4.29	6.61	9.06	11.64
Trade	0.45	0.88	1.31	1.72	2.12
Government services	-4.42	-8.93	-13.52	-18.19	-22.92
Other services	2.61	5.31	8.11	11.01	14

In the first case, the increase in exports exceeds the drop in domestic private consumption (hence the increase in capital returns). The tertiary sector is the most affected by expenditure reduction: as a whole its supply contracts up to 1.11%. This can be explained by the strong fall of government services (up to 23%). Simultaneously, a reduction in public services explains the significant drop in urban labor's returns. Because the model assumes full

employment, labor released from government services is mostly absorbed by other services favored by the devaluation (tourism, transport and telecommunications, etc.).¹⁶

Concerning foreign trade (Table 28), the real depreciation of the *córdoba* exports expand by up to 12.5% whereas imports fall by a maximum of 7.4%, clearly improving the external balance, which declines from 443 million to 325 million dollars.

¹⁶As we mentioned before, the CGE model ignores the transition process from one equilibrium to the next, during which - and as can be observed in Nicaragua - unemployment reaches dramatic figures. See Yúnez-Naude (1992).

Table 28
Impact on foreign trade (Base year percentage change)

Cost reduction	5%	10%	15%	20%	25%
<i>Exports</i>					
Agricultural exports	1.18	2.27	3.27	4.19	5.03
Other agricultural	1.89	3.68	5.37	6.97	8.47
Forestry, hunting, & fishing	2.41	4.70	6.85	8.88	10.78
Agroindustry	2.45	4.83	7.13	9.35	11.48
Manufactures	0.71	1.40	2.06	2.70	3.32
Mining	2.80	5.71	8.75	11.92	15.22
Other services	5.75	11.72	17.91	24.34	30.98
TOTAL	2.52	5.03	7.53	10.03	12.53
<i>Imports</i>					
Agricultural exports	-0.01	0.02	0.06	0.13	0.20
Basic grains	-2.29	-4.39	-6.32	-8.10	-9.74
Other agricultural	-2.29	-4.42	-6.40	-8.26	-9.99
Forestry, hunting, & fishing	-2.31	-4.48	-6.53	-8.46	-10.28
Livestock	-1.75	-3.37	-4.87	-6.25	-7.52
Agroindustry	-2.08	-4.02	-5.82	-7.49	-9.05
Manufactures	-0.94	-1.82	-2.65	-3.42	-4.14
Construction	-2.68	-5.18	-7.51	-9.67	-11.68
Mining	-1.30	-2.54	-3.73	-4.87	-5.95
Trade	-2.31	-4.44	-6.43	-8.26	-9.96
Government services	-7.87	-15.25	-22.20	-28.73	-34.90
Other services	-2.30	-4.44	-6.45	-8.32	-10.07
TOTAL	-1.70	-3.29	-4.77	-6.16	-7.46
Real trade balance*	-4.70	-9.21	-13.53	-17.68	-21.67

5.3.1.c. *Income distribution.* Global income grows up to 0.7% favoring rural sectors, most benefited when investment is fixed. Rural labor increases its income by 0.9% and the rural intermediate sector by 0.2%. Because land returns grow by up to 7%, the intermediate farmer income increases by almost 4%, and their share by 0.2%. In contrast, urban sectors suffer reductions both in their returns and in their participation in income.

Table 29
Impacts on income distribution

Cost reduction	5%	10%	15%	20%	25%
Base year percentage change					
Households					
High capitalist	-0.84	-1.70	-2.58	-3.49	-4.42
Middle urban	-0.40	-0.80	-1.22	-1.66	-2.10
Middle rural	-1.33	-2.69	-4.09	-5.53	-7.00
Lower urban	0.00	0.01	0.02	0.02	0.02
Lower rural	0.27	0.54	0.82	1.10	1.38
Participation in total income					
Households					
High capitalist	-0.1	0.0	0.8	-0.5	1.9
Middle urban	-0.3	0.1	1.6	-0.9	3.7
Middle rural	-0.3	0.1	2.4	-1.4	5.4
Lower urban	-0.4	0.1	3.2	-1.8	7.1
Lower rural	-0.5	0.2	4.0	-2.2	8.7

5.3.1.d. Other aggregate variables. Government revenues grow by up to 2.8% when the cuts in public spending reach 25%. This causes large growth in public savings (up to 65%).

Tariffs are the only form of reduced revenue due to declining imports. Indirect tax revenues grow the most with the expansion of agroindustry and manufacturing, which together represent 75% of the GVT and the CST. Foreign aid fixed in dollars - rises in real terms, with depreciation greater than the price increase. Given that total investment is fixed and that private savings barely grow, foreign dissavings offset the increase in public savings. In real terms, consumption drops up to 1.5%, though it increases in nominal terms. Because investment remains constant, the impact of a reduction in public expenditure generates a fall in the real GDP. Therefore, the reduction in government spending leads to an improvement

of fiscal and external balances but it depresses the GDP slightly. Income redistribution favors the rural sectors. Our model assumes full employment, so it does not allow us to capture unemployment effects, nor the impact of reduced health and education services.

Table 30
Results of other aggregate variables
(Base level in millions of Cordobas. Base year percentage change)

Cost reduction	Base	5%	10%	15%	20%	25%
Government	1483.90	0.00	0.00	0.00	0.00	0.00
Investment	1463.76	0.00	0.00	0.00	0.00	0.00
Private consumption	6675.20	-0.37	-0.69	-0.98	-1.24	-1.46
Family savings*	2.52	-14.95	-28.54	-40.79	-51.68	-61.22
Government savings	730.11	130.19	260.23	390.11	510.83	640.38
Enterprise savings	150.21	0.59	1.18	1.78	2.39	2.99
Net foreign savings	581.00	-17.93	-35.11	-51.59	-67.42	-82.65
Remittances	800.90	0.00	0.00	0.00	0.00	0.00
Government income	2505.93	0.59	1.17	1.74	2.29	2.83
Tariff	266.99	-0.26	-0.52	-0.76	-0.99	-0.21
Indirect tax	804.02	0.37	0.75	0.14	0.53	0.93
Households direct tax	192.21	-0.02	-0.02	-0.02	16.49	0.02
Enterprise direct tax	59.20	0.59	1.18	1.78	2.39	2.99
Consumption tax	404.62	0.07	0.14	0.20	0.27	0.33

5.3.2. Fixed foreign savings and endogenous investment

In this simulation, public savings foster investment and therefrom they require a smaller currency depreciation in real terms for the external sector to be balanced. Restoring the health of public finances comes with fostering private activity, allowing the industrial sector to absorb a good part of public unemployment.

b5.3.2.a. Prices. The required devaluation is now smaller than in the previous closing, reaching 2.93% with an expenditure reduction of 25% (Table 31). Inflation is also lower with the NCPI at 0.5% and the GDP deflator at 0.21% in the case of a maximum expenditure reduction. The impact of the policy change on factor payment is smaller than in the previous closing. It still benefits rural labor, though to a lesser degree (3.9% with a 25% expenditure reduction), whereas urban labor returns fall to a maximum of 6.3%. Capital returns increase (of up to 4%), returns to land rise to a maximum of 3.6%.

Table 31
Impact on prices (Base year percentage change)

Cost reduction	5%	10%	15%	20%	25%
GDP deflator	0.04	0.09	0.15	0.22	0.30
Consumer price index	-0.09	0.37	0.28	0.34	0.49
Producer price index	0.00	0.00	0.00	0.00	0.00
<i>Factor payments</i>					
Rural labor	0.8	1.59	2.37	3.13	3.88
Urban labor	-1.33	-2.62	-3.87	-5.1	-6.29
Capital (urban & rural)	0.81	1.61	2.4	3.19	3.97
Land	0.74	1.47	2.19	2.91	3.62
Exchange rate	0.61	1.2	1.79	2.36	2.93

5.3.2.b. Production, employment, and trade. Real GDP increases up to 0.6% (Table 32). Reduction in the tertiary sector is more than offset by the expansion of industry which grows up to 7.25%. In the primary sector GDP barely changes (with a maximum reduction of 0.11%). There is a smaller expansion of agroexporting sectors, with more limited devaluation. The stock raising sector no longer contracts. Given the growth of investment and the growth in imports linked to higher GDP, the secondary sector, construction,

manufacturing and mining expands. This offsets in part the impact of the reduced public employment. In the case of agroindustry, the reduction in internal consumption is not fully replaced by export demand, so the sector undergoes a marginal drop of up to 0.2%.

Table 32
Impact on production (Real GDP) (Base year percentage change)

REDUCCION DEL GASTO	5%	10%	15%	20%	25%
<i>Aggregate GDP</i>					
Total GDP	0.13	0.26	0.38	0.49	0.60
Primary GDP	-0.02	-0.05	-0.07	-0.09	-0.11
Secondary GDP	1.48	2.94	4.39	5.83	7.25
Tertiary GDP	-0.66	-1.33	-2.00	-2.67	-3.35
<i>Sectoral GDP</i>					
Agricultural exports	0.04	0.07	0.09	0.11	0.11
Basic grains	-0.21	-0.4	-0.59	-0.78	-0.95
Other agricultural	-0.16	-0.32	-0.48	-0.65	-0.81
Forestry, hunting, & fishing	0.21	0.41	0.59	0.76	0.91
Livestock	20.88	0.01	0.03	0.05	0.08
Agroindustry	-0.06	-0.12	-0.18	-0.23	-0.28
Manufactures	1.89	3.75	5.6	7.43	9.24
Construction	7.25	14.42	21.5	28.49	35.41
Mining	1.4	2.82	4.24	5.66	7.1
Trade	0.38	0.76	1.14	1.51	1.89
Government services	-4.67	-9.38	-14.13	-18.93	-23.76
Other services	1.32	2.67	4.04	5.44	6.86

Finally, the tertiary sector has a significant fall of 3.35% when the reduction in public spending reaches 25%, because government services represent a little more than one fourth of the economy's tertiary GDP. In the foreign sector (Table 33), the simulation suggests an expansionism imports (given the momentum of investment) of up to 2.2% and an increase in exports of up to 5.2%.

Table 33
Impact on foreign trade (Base year percentage change)

Cost reduction	5%	10%	15%	20%	25%
<i>Exports</i>					
Agricultural exports	-0.06	-0.13	-0.21	-0.29	-0.39
Other agricultural	0.24	0.47	0.69	0.9	1.09
Forestry, hunting, & fishing	0.39	0.76	1.12	1.46	1.77
Agroindustry	0.45	0.88	1.31	1.73	2.14
Manufactures	2.13	4.25	6.35	8.44	10.52
Mining	1.68	3.36	5.06	6.77	8.49
Other services	2.79	5.65	8.57	11.55	14.59
TOTAL	1.03	2.07	3.12	4.17	5.23
<i>Imports</i>					
Agricultural exports	0.75	1.49	2.23	2.97	3.7
Basic grains	-0.66	-1.28	-1.88	-2.45	-2.99
Other agricultural	-0.95	-1.87	-2.76	-3.63	-4.48
Forestry, hunting, & fishing	-1.24	-2.46	-3.66	-4.86	-6.03
Livestock	-0.2	-0.38	-0.54	-0.68	-0.81
Agroindustry	-0.77	-1.52	-2.25	-2.95	-3.63
Manufactures	1.55	3.07	4.57	6.04	7.5
Construction	5.99	11.77	17.35	22.73	27.93
Mining	0.12	0.22	0.31	0.38	0.44
Trade	-0.7	-1.37	-2.02	-2.66	-3.27
Government services	-6.65	-13.07	-19.27	-25.27	-31.06
Other services	-1.01	-2	-2.95	-3.88	-4.79
TOTAL	0.43	0.86	1.3	1.73	2.17
Real trade balance*	0.00	0.00	0.00	0.00	0.00

*The balance on the Trade Balance is of -22158 millions of cordobas for the base year

5.3.2.c. *Income distribution.* Income redistribution always favors rural sectors, but somewhat less so in this closing compared to the previous one (Table 34). Rural labor and intermediate farmers, increase their share by up to 0.4%. There are reductions in the shares of intermediate, capitalist and urban workers sectors.

Table 34

Impacts on income distribution

Cost reduction	5%	10%	15%	20%	25%
Base year percentage change					
Households					
High capitalist	-0.02	-0.03	-0.03	-0.02	-0.01
Middle urban	-0.05	-0.08	-0.12	-0.14	-0.16
Middle rural	0.78	1.55	2.32	3.08	3.83
Lower urban	-0.50	-0.99	-1.46	-1.92	-2.36
Lower rural	0.79	1.57	2.35	3.10	3.85
Cost reduction	5%	10%	15%	20%	25%
Participation in total income					
Households					
High capitalist	32.2	32.2	32.2	32.2	32.1
Middle urban	34.5	34.5	34.4	34.4	34.4
Middle rural	6.2	6.3	6.3	6.4	6.4
Lower urban	16.6	16.5	16.4	16.3	16.2
Lower rural	10.5	10.6	10.7	10.8	10.8

5.3.2.d. *Other aggregate variables.* Industrial expansion increases tax revenues, which grow up to 3.8% with a 25% reduction in government spending. This comes from growth in indirect taxes (fiscal industry) and the increase in import duties (Table 35). The increase in public savings is larger in this closing (of up to 68%) compared to the previous one. Because intermediate and urban professional sectors do not see their incomes deteriorate, direct and consumer taxes also grow. Investment grows up to 33.8%. To conclude, a contraction in public spending causes a significant reduction of the public deficit. It also improves the external balance if the *córdoba* depreciates. If the external balance does not vary, the classic “displacement” effect takes place through investment. The contraction in public employment is absorbed in part by the increase in employment in other services or in industry. Redistributive effects favor rural labor, capital, and land.

Table 35**Results of other aggregate variables. (Base level in millions of Cordobas. Base year percentage change)**

Cost reduction	Base	5%	10%	15%	20%	25%
Government consumption	1483.9	0.00	0.00	0.00	0.00	0.00
Investment	1463.8	7.29	14.5	21.63	28.68	35.64
Private consumption	6675.2	-0.26	-0.5	-0.73	-0.94	-1.14
Family savings*	2.5	17.58	35.02	52.34	69.54	86.63
Government savings	730.1	0.00	0.00	0.00	0.00	0.00
Enterprise savings	150.2	13.91	27.67	41.27	54.71	68.01
Net foreign savings	581.0	0.81	1.61	2.4	3.19	3.97
Remittances	800.9	0.00	0.00	0.00	0.00	0.00
Government income	2505.9	0.78	1.55	2.31	3.07	3.81
Tariff	267.0	0.94	1.88	2.81	3.75	4.68
Indirect tax	804.0	1.13	2.25	3.36	4.47	5.56
Households direct tax	192.2	-0.05	-0.08	-0.11	-0.14	-0.15
Enterprise direct tax	59.2	0.81	1.61	2.4	3.19	3.97
Consumption tax	404.62	0.68	1.35	2.02	2.69	3.34

VI. Conclusions

The Nicaraguan economy emerged from the armed conflict of the eighties with hyperinflation, unsustainable foreign and fiscal gaps, and obsolete industry heavily dependent on imports and a primary sector that sustained the national economy. Despite the fact that a consequence of the armed conflict was a more equitable land distribution than in most Latin American countries, small producers have hardly benefited from agricultural and stock-raising policies. During the 1990s, stabilizing the economy was sustained by extreme monetary, credit and fiscal discipline, accompanied by a modification of the government's role, from a determiner to facilitator of economic growth. The new national development strategy emphasizes the private sector as assigns exports as the driver of economic growth. This program promotes primary sector exports. The fixed exchange rate system implemented in 1991 and 1992 proved to be an efficient anchor for prices, but was insufficient to stimulate primary exports. After 1993, a sliding exchange rate system was implemented to facilitate real devaluation of the currency.

Devaluation with fiscal discipline and investment fixed (first closure), brings about an improvement in the foreign balance and favors lower income households - especially rural ones - but also contracts the economy with general loss of welfare. The result is nothing new: in a small, open and poorly articulated economy like Nicaragua, where imports exceed half of the GDP and have greater weight in the secondary sector and in investment, devaluations are recessive (Krugman and Taylor, 1978).

Previous studies on Nicaragua suggest that a policy of devaluation requires higher public expenditures to compensate for contractionary effects (Arauz, 1992). In the second closure when investment is no longer fixed, results show steeper declines in output and welfare (though softer ones in income distribution). These results indicate that economic reactivation can be based not only on the dynamism of tradable good production, but also on the multiplier effects they can generate. In this sense, a “democratic” reactivation that includes small producers in tradable good production (high elasticity - income sectors) could be more efficient in achieving economic growth and a reduction of rural poverty (IICA, 1991). State investment can also be a pivotal element in the generation and expansion of intersectoral linkages. Such investments, as reported by Nicaragua’s Banco Central in its 1996 report, have been financed up to now primarily by foreign loans.

In the second group of simulations, tariff liberalization leads in all cases to gains in efficiency. The effects are more palpable when the exchange rate is fixed and a substitution of public savings for foreign ones takes place. A reduction of tradable goods relative to domestic goods produces an appreciation of the real exchange rate. Corporate sectors - mostly urban ones - are the ones that benefit the most from the lower prices of imports. A reduction of tariffs reduces the ability of competing with imported products, which is reflected in a significant growth of consumer goods imports. The depression of the primary sector is also notable, particularly in the subsector of basic grain producers despite the expansion of consumption. In general, the substitution effect prevails over the income effect in the

liberalization scenario. The aggregation of the manufacturing sector in the SAM does not allow us to capture differentiated impacts in the secondary sector. Based on the aggregate result and on additional information, however, we can state that the domestic production of textiles, clothing, leather and shoes is impacted since it cannot compete with imported products (Dijkstra, 1995, p. 121).

As the expansion of the economy and consumption generates greater fiscal income, this cannot compensate for the decrease in tariff collection such that the fiscal gap deepens. The real exchange rate also appreciates, worsening the foreign gap. Undoubtedly this situation cannot be sustained without the continued inflow of foreign resources. When the exchange rate is left to vary and foreign savings are fixed, the effect of tariff liberalization in production and efficiency, though positive, is smaller than in the previous case. This is due to the fact that the depreciation of the *córdoba* operates in the opposite direction of tariff reductions on import prices. Distribution of income begins to favor rural workers due to the momentum of agroexporting sectors. In this case, if the government seeks to compensate the loss in tariff income with taxes on the private sector, consumption gets depressed. If the government accepts lower income and a greater fiscal deficit, investment is impacted. An alternative could be expanding public investment, which is closely linked to foreign resources as was stated before.

To summarize, trade liberalization results in gains in efficiency, but it also deepens fiscal or external unbalances, depending on how the exchange rate is handled. The agricultural and

cattle-raising sector does not see results from these gains, because the expansion of consumption focuses basically on imported products. Only the agroexporting sub-sectors can benefit when there are devaluations in the real exchange rate. Due to its static nature, the model does not capture each step in the transition process towards efficiency industry, with obsolete equipment and an oligopolistic market structure that bases its benefits on fixing a margin over costs based on depressed salaries. Paradoxically, gains in efficiency depend, in part, on a transition away from such industries.

In the contraction of public spending scenario, we found the efficiency gains to be more significant when the exchange rate is allowed to depreciate and when the foreign balance is fixed. Thus we get a “displacement” effect with a strong expansion of investment that fosters industrial activity. The reduction of public employment causes a negative impact on domestic consumption, a phenomenon that may partly explain the depression in the supply of basic

grains and of agro-industrial products¹⁷. When investment is fixed and the foreign account is liberated, on the other hand, an improvement in the foreign balance occurs along with

¹⁷ We know that an immediate and direct effect of economic reforms – particularly of reducing public spending – is an increase in unemployment and a reduction in the health and education services. The model does not capture this behavior because it assumes full employment and due to the lack of information on the components of public spending, respectively. Regarding employment, we can say that the model is long term, it considers that in sufficiently long period of time, the economy will be employing fully all the Nicaraguan

healthier public finances and an important stimulation of the exporting sector. In this scenario, however, industry is not so favored, and impacts on welfare do not have the “displacement” effect we described before.

The results we presented show the importance of investment in the success of the structural modification processes. The experience that emerged from the internal and external liberalization programs applied to Latin American economies shows that they are not enough to create an environment that fosters the growth of national and foreign private investment. This shows that the active participation of the government is necessary and, especially, that the retraction of the state in the economy should be accompanied by new government regulations, by institutional change and by the creation of new public institutions¹⁸.

labor force. In contrast, the open unemployment rate went from 11.1% in 1990 to 21.8% in 1993 and, if sub-employment is included, it went from 39.4% to 50.1% during that same period and the employment in the public sector was reduced from 284,000 positions in 1990 to 87,000 in 1996 (Banco Central de Nicaragua, Annual Report, 1996).

¹⁸ The importance of what was just mentioned can be observed in the Nicaraguan case. The recent experience of this country shows that when the state leaves the market, it is common for the private sector not to occupy the space that was left or for it to take advantage of the lack of competition, hence damaging the market (Clemens, 1992). An example is the experience of the incipient Nicaraguan financial market. Its oligopolic, or poorly competitive structure in an unstable macroeconomic environment, where bank supervision is still ineffective, allowed it to establish very high interest rates in “gentlemen’s agreements”. In fact, Nicaragua had the highest real interest rates of Central America during the first years of the nineties. The real active rates in Nicaragua went from -5.2% in 1989 to 19.4% in 1991 (the year of the SAM used in this study). The 1991 rate was way over that of Costa Rica

The stabilizing and “outward” oriented development policies that we studied promote a healing of the fiscal and foreign unbalances, but they cause contradictory effects on the economy. As in other Central America countries, Nicaragua set out on a model of opening to the exterior and of deregulation. Though the contraction in public spending and tariff reduction seem to generate a greater economic efficiency - most of all when a certain exchange rate depreciation is allowed - these policies do not guarantee a harmonious growth of the economy. Along with the need to foster, orient and regulate private and public investment, there is a need for a body of microeconomic policies that foster intersectoral linkages. The foundation for future growth would undoubtedly be in the agricultural, stock-raising and agro-industrial sectors, because they are the most competitive ones in the process of opening to the exterior. International cooperation resources should be oriented towards

(12.3%), the Central American country that traditionally has the highest rates (Statistics of the Central American Monetary Council). Also, the bank portfolio directed itself mainly to the trade sector (this behavior had already taken place in the 1960s), affecting the industrial and agricultural and stock-raising sectors (for example, the 102, 000 country families that received some kind of formal credit in 1988 were reduced to 37,000 during 1991 (UNAG, 1993)) causing a contracting sequel.

these policies, since only through their implementation will it be possible to conduct a competitive re-industrialization.

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APPENDIX 1. NIC														
=====														
ACTIVITIES														

	1	2	3	4	5	6	7	8	9	10	11	12	SUBTOT	
=====														
COMMODITIES														
1	Export agriculture	7,4	0,0	0,0	0,0	0,0	284,8	0,0	0,0	0,0	0,0	0,0	0,0	292,2
2	Basic grains	0,0	4,6	0,0	0,1	19,4	11,0	0,0	0,0	0,0	0,0	4,4	0,1	39,8
3	Other agriculture	0,0	0,0	0,7	0,0	0,0	0,9	0,0	0,0	0,0	0,0	10,8	1,7	14,2
4	Forestry, hunting &	0,0	0,0	0,0	0,0	0,0	6,2	1,6	0,0	2,1	0,0	8,1	2,6	20,6
5	Livestock	0,0	0,0	0,0	0,0	0,0	70,5	0,0	0,0	0,0	0,0	4,4	1,2	76,1
6	Food Processing	5,2	2,3	0,5	0,3	34,7	57,7	2,5	0,0	0,0	3,4	91,4	16,5	214,5
7	Manufactures	4,8	4,1	1,1	2,0	9,9	15,9	7,4	86,3	3,1	69,0	174,9	178,3	556,8
8	Construction	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	Mining	0,0	0,0	0,0	0,0	0,0	1,0	0,5	6,5	0,0	0,0	9,2	0,0	17,3
10	Commerce	121,3	134,3	52,1	38,8	326,6	608,6	294,6	18,4	22,5	22,6	48,9	108,8	1.797,4
11	Gov.Services	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
12	Other Services	6,8	8,0	0,8	0,6	18,5	16,7	2,8	35,5	8,1	138,8	94,5	349,8	680,9

SUBTOT		145,5	153,3	55,3	41,8	409,0	1.073,3	309,5	146,8	35,8	233,8	446,5	659,1	3.709,7
=====														
ACTIVITIES														
1	Export agricult.													
2	Basic grains													
3	Other agriculture													
4	Fores,hunt & fish													
5	Livestock													
6	Food Processing													
7	Manufactures													
8	Construction													
9	Mining													
10	Commerce													
11	Gov.Services													
12	Other Services													

SUBTOT														
=====														
FACTORS														
LABOR		298,5	50,5	29,8	23,4	195,3	119,3	236,6	74,6	12,2	618,2	772,7	478,5	2909,5
- Urban		0,0	0,0	0,0	0,0	0,0	119,3	236,6	74,6	12,2	618,2	772,7	478,5	2.312,0
- Rural		298,5	50,5	29,8	23,4	195,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	597,5
CAPITAL		230,3	216,4	59,8	40,9	415,4	523,0	416,5	45,5	18,4	820,2	0,0	253,7	3039,9

APPENDIX 1. NIC													
=====													
ACTIVITIES													

	1	2	3	4	5	6	7	8	9	10	11	12	SUBTOT
=====													
SUBTOT	528,8	266,8	89,6	64,3	610,6	642,2	653,1	120,0	30,6	1.438,3	772,7	732,2	5.949,4
=====													
I HOUSEHOLDS													
High													
N 1/2 Urban													
1/2 Rural													
S Low Urban													
Low rural													
T -----													
SUBTOTAL													
I =====													
FIRMS													
T =====													
GOVERNMENT													
U Ind.taxes (incl. IG	24,1	39,9	4,0	8,0	52,6	168,1	331,6	27,2	3,3	30,3	18,9	96,0	803,8
Ind.tax(incl.ISC)													
T Import taxes													
Direct taxes													
I Transfers													
Other revenue													
O -----													
N SUBTOT	24,1	39,9	4,0	8,0	52,6	168,1	331,6	27,2	3,3	30,3	18,9	96,0	803,8
=====													
REST OF THE WORLD													
USA													
Central America													
Mexico													
Other regions													
T -----													
SUBTOT													
=====													
CAPITAL ACCOUNT													
=====													
T O T A L	698,3	460,1	149,0	114,1	1.072,2	1.883,6	1.294,1	294,0	69,7	1.702,3	1.238,2	1.487,4	10.463,0

APPENDIX 1. NIC																	
FACTORS				I N S T I T U T I O N S													
LABOR		CAPITAL		H O U S E H O L D S													
Urban		Rural		TOTAL		High		1/2 Urban		1/2 Rural		Low Urban		Low rural		SUBTOT	
COMMODITIES																	
1	Export agriculture					10,0	10,6	1,7	5,8	3,8	31,9						
2	Basic grains					135,2	143,2	22,8	78,6	51,1	430,9						
3	Other agriculture					29,1	30,9	4,9	16,9	11,1	92,9						
4	Forestry, hunting &					6,1	6,4	1,0	3,5	2,3	19,3						
5	Livestock					315,8	334,4	53,2	183,4	119,3	1006,0						
6	Food Processing					537,1	568,7	90,4	312,0	203,1	1711,3						
7	Manufactures					345,2	365,5	58,0	200,5	130,4	1099,6						
8	Construction					0,0	0,0	0,0	0,0	0,0	0,0						
9	Mining					7,1	7,6	1,2	4,1	2,7	22,7						
10	Commerce					0,0	0,0	0,0	0,0	0,0	0,0						
11	Gov.Services					0,0	0,0	0,0	0,0	0,0	0,0						
12	Other Services					232,7	246,4	39,2	135,2	88,0	741,5						
SUBTOT						1.618,3	1.713,8	272,2	940,1	611,8	5.156,1						
ACTIVITIES																	
1	Export agricult.																
2	Basic grains																
3	Other agriculture																
4	Fores,hunt & fish																
5	Livestock																
6	Food Processing																
7	Manufactures																
8	Construction																
9	Mining																
10	Commerce																
11	Gov.Services																
12	Other Services																
SUBTOT																	
FACTORS																	
LABOR																	
- Urban																	
- Rural																	
CAPITAL																	

APPENDIX 1. NIC											
FACTORS				I N S T I T U T I O N S							
LABOR			CAPITAL		H O U S E H O L D S						
Urban			Rural	Subtot	TOTAL	High	1/2 Urban	1/2 Rural	Low Urban	Low rural	SUBTOT
SUBTOT											
I HOUSEHOLDS											
High 862,0 0,0 862,0 650,6 1512,6											
N 1/2 Urban 836,8 0,0 836,8 900,6 1737,3											
1/2 Rural 0,0 0,0 0,0 404,4 404,4											
S Low Urban 613,3 0,0 613,3 127,7 740,9											
Low rural 0,0 597,5 597,5 102,7 700,2											
SUBTOTAL 2.312,0 597,5 2.909,5 2.185,9 5.095,4											
I FIRMS 904,5 904,5											
T GOVERNMENT											
U Ind.taxes (incl. IG)											
Ind.tax(incl.ISC)											
T Import taxes											
Direct taxes 34,9 128,8 9,5 19,0 0,0 192,2											
I Transfers 74,7 74,9 0,0 63,9 0,0 213,5											
Other revenue											
O											
N SUBTOT 109,6 203,7 9,5 82,9 0,0 405,7											
REST OF THE WORLD											
482,1 510,7 81,2 280,1 182,5 1536,6											
USA											
Central America											
Mexico											
Other regions											
SUBTOT 482,1 510,7 81,2 280,1 182,5 1.536,6											
CAPITAL ACCOUNT											
82,2 21,8 66,5 (98,9) (69,1) 2,4											
T O T A L 2.312,0 597,5 2.909,5 3.090,4 5.999,9 2.292,1 2.449,9 429,4 1.204,2 725,2 7.100,8											

APPENDIX 1. NIC										
=====										

	FIRMS	GOVERNMENT	REST OF THE WORLD				CAPITAL			
			USA	CA	MEX.	OTHER R.	TOTAL	ACCOUNT	TOTAL	
=====										
COMMODITIES										
1	Export agriculture	0,0						33,7	357,8	
2	Basic grains	0,0						10,1	480,8	
3	Other agriculture	0,0						2,3	109,3	
4	Forestry, hunting &	0,0						0,8	40,8	
5	Livestock	0,0						59,5	1.141,7	
6	Food Processing	0,0						36,1	1.961,9	
7	Manufactures	0,0						33,4	1.689,9	
8	Construction	0,0						372,9	372,9	
9	Mining	0,0						0,8	40,8	
10	Commerce	0,0						0,0	1.797,4	
11	Gov.Services	1483,9						0,0	1.483,9	
12	Other Services	0,0						0,0	1.422,3	
SUBTOT		1.483,9						549,8	10.899,5	
=====										
ACTIVITIES										
1	Export agricult.							525,9	698,3	
2	Basic grains							0,0	460,1	
3	Other agriculture							48,4	149,0	
4	Fores,hunt & fish							89,0	114,1	
5	Livestock							0,0	1.072,2	
6	Food Processing							319,9	1.883,6	
7	Manufactures							202,3	1.294,1	
8	Construction							0,0	294,0	
9	Mining							45,3	69,7	
10	Commerce							0,0	1.702,3	
11	Gov.Services							0,0	1.238,2	
12	Other Services							345,1	1.487,4	
SUBTOT								1.575,9	10.463,0	
=====										
FACTORS										
	LABOR								2.909,5	
	- Urban								2.312,0	
	- Rural								597,5	
	CAPITAL							50,5	3.090,4	

APPENDIX 1. NIC											
		FIRMS	GOVERNMENT				REST OF THE WORLD			CAPITAL ACCOUNT	TOTAL
					USA	CA	MEX.	OTHER R.	TOTAL		
	SUBTOT								50,5		5.999,9
I	HOUSEHOLDS										
	High	699,5	29,5						50,5		2292,1
N	1/2 Urban		240,1						472,5		2449,9
	1/2 Rural		0,0						25,0		429,4
S	Low Urban		235,8						227,5		1204,2
	Low rural		0,0						25,0		725,2
T	SUBTOTAL	699,5	505,4						800,5		7.100,8
I	FIRMS								64,4		968,9
T	GOVERNMENT										
U	Ind.taxes (incl. IG										803,8
	Ind.tax(incl.ISC)										404,6
T	Import taxes										267,0
	Direct taxes	59,2									251,4
I	Transfers										213,5
	Other revenue				891,7				891,7		891,7
O	SUBTOT	59,2			891,7				891,7		2.832,0
N	REST OF THE WORLD	60,0	112,5							913,9	3963,9
	USA										
	Central America										
	Mexico										
	Other regions										
	SUBTOT	60,0	112,5							913,9	3.963,9
	CAPITAL ACCOUNT	150,2	730,2						580,9		1.463,7
T O T A L		968,9	2.832,0						3.963,9	1.463,7	

APPENDIX 2: THE CGE MODEL¹⁹

We run a Computable General Equilibrium Model (CGE), a static economy model with competitive markets (see Devajaran et al, 1994, Robinson 1989, 1990, and Yúnez 1991, 1992 and 1995), to analyze the effects of economic policies and external shocks. The effects we are concerned are the direction and magnitude of economywide changes: exchange policies, tariff policies, and fiscal policies. GAMS (General Algebraic Modeling System, Broke et al 1988) was the program used to run the CGE (based in Robinson et al, 1990). The Social Accounting Matrix build for 1991 was its framework.

First we present the price equations, then the supply (quantity) equations, the income equations (interinstitutional flows), the demand (expenditure) equations and finally the equilibrium equations (supply=demand) with the different closure restrictions.

Endogenous variables are in capital letters, while exogenous variables are always in lowercase or Greek letters.

In subscript we get the sectors (i and j), primary production factors (f) and households (h) that have capitalists households (cap) and workers (trab).

In superscript we get imports (m), exports (e), composed commodities (q for CES and x for CET²⁰), value added (v), capital (k) and domestic (D).

¹⁹ This appendix is based in Robinson (2000)

²⁰ CES is constant elasticity substitution function and CET, constant elasticity transformation function

VARIABLES

C	Final demand for private consumption	M	Imports
D	Domestic sales of domestic output	P ^d	Domestic sales price
DEPREC	Total depreciation charges	P ^e	Domestic price of exports
DK	Investment by sector of destination	P ^k	Price of a unit of capital (each sector)
DST	Inventory investment by sector	P ^m	Domestic price of imports
E	Exports	P ^q	Price of composite good
FSDC	Factor demand	P ^v	Value added price
FSAV	Foreign savings	PW	World price of exports
FXDINV	Fixed capital investment	P ^x	Output Price
G	Government final demand	PINDEX	GDP deflator
GDPVA	Nominal GDP in market prices	Q	Composite goods supply
GOBSAV	Government savings	R	Exchange rate
GR	Total government revenue	RGDP	Real GDP
HHSAV	Total household savings	SAVING	Total savings
HHTAX	Total tax revenue	TARIFF	Tariff revenue
ID	Final demand for investment goods	WF	Average price factor
INDTAX	Total indirect tax revenue	X	Domestic Output
INT	Intermediate input demand	Y ^F	Factor income
INVEST	Total investment	Y ^H	Household income

PARAMETERS

a _{ji}	Input-output coefficients	pwse	World price of export substitutes
a ^C	CES function shift parameter	t ^H	Household income tax revenue
a ^D	Production shift parameter	t ^m	Tariff rate on imports
a ^T	CET function shift parameter	t ^x	Indirect tax rates
b	Capital composition matrix	wfdist	Factor market distortion parameters
depr	Depreciation rate	α	Production function exponents
dstr	Inventory investment ratio	β ^G	Government expenditure shares
econ	Export demand shift parameter	β ^H	Household expenditure shares
fs	Aggregate factor supply	δ	CES function share parameter
gdtot	Real government consumption	η	Export demand elasticity
kshr	Investment destination shares	γ	CET function share parameter
mps	Household saving rates	ρ	CES function exponent
pw	World price of imports		

I.- PRICE EQUATIONS

The model establishes the “small economy” assumption for imports (m) and exports (e), that is, world prices (pw^m , pw^e) are exogenous and fixed in the global market. Both domestic prices (import and export) include tariffs (t) times the exchange rate (R).

$$(1) \quad P_i^m = pw_i^m (1 + t_i^m)R$$

$$(2) \quad P_i^e = pw_i^e (1 + t_i^e)R$$

There are imperfect substitutability of goods produced domestically, D, and imported, M. Both are linked in a composite consumer good Q, with price P^q , by a CES function. The economy produced two differentiated commodities, one for the domestic market, D, and the other for the foreign, E. Both goods are aggregated in X, the sectoral total production by a CET function²¹.

$$(3) \quad P_i^q = \frac{P_i^d \cdot D + P_i^m \cdot M}{Q}$$

$$(4) \quad P_i^x = \frac{P_i^d \cdot D + P_i^e \cdot E}{X}$$

The value added or net price P^v is the sectoral price P^x less indirect taxes (t^x) and the input prices based in coefficients input-output (a_{ij}). $P^v X$ is the value added of each activity.

²¹ See the elasticities used in the CES and CET functions in Table 1, page 18

$$(5) \quad P_i^v = P_i^x (1 - t_i^x) - \sum_j P_j^q \cdot a_{ji}$$

The price for unit of capital P^k is the weighted average of the unit cost of capital goods required to create a unit of capital in each investment sector, based in capital coefficients b_{ij} . We assume that the investment, saving and demand of capital goods are not used in the period. The model is static, so the capital stock is exogenous fixed. Investment does not have any effect in supply.

$$(6) \quad P_i^k = \sum_j P_j^q \cdot b_{ji}$$

Finally we define the aggregate index price (PINDEX), deflator of Gross Domestic Product, as the usual form: nominal GDP divided the real one. This is the numeraire for relative prices.

$$(7) \quad PINDEX = \frac{GDPVA}{RGDP}$$

II.- SUPPLY (QUANTITY) EQUATIONS

The production function is nested. The technology is represented by Cobb-Douglas functions for primary inputs (FDSC: land, capital, rural and urban labor) in fixed combinations with intermediate goods.

$$(8) \quad X_i = a_i^D \prod_f FDSC_{if}^{\alpha_{if}}$$

Next we have the primary factor demand functions. The first order conditions imply that the price of factors equals the value added price net of taxes and intermediate inputs P^v (equation 5) times the partial derivative of the production function. Primary factors are paid with an average rent WF_f . In countries like Nicaragua salaries and net income differs between sectors. We get a specific parameter, wf_{dist}_{if} , representing the deviation from the average of the whole economy.

$$(9) \quad WF_f \cdot wf_{dist}_{if} = P_i^v \cdot \alpha_{if} \frac{X_i}{FDSC_{if}}$$

The intermediate inputs (INT) are required according the fixed input-output coefficients a_{ij} , where each intermediate income is a CES aggregate of domestic and import goods.

$$(10) \quad INT_i = \sum_j a_{ij} \cdot X_j$$

The total domestic production (X) is supplied to exports (E) and domestic sales (D), combined in a CET transformation function, while exports (E) supply depend on relative prices (P^e/P^d).

$$(11) \quad X_i = a_i^T \left[\gamma_i E_i^{p_i^T} + (1 - \gamma_i) D_i^{p_i^T} \right]^{\frac{1}{p_i^T - 1}}$$

$$(12) \quad E_i = D_i \left[\frac{P_i^e (1 - \gamma_i)}{P_i^d \cdot \gamma_i} \right]^{\frac{1}{p_i^T}}$$

The composite good (Q) is aggregate by a CES function of imports (M) and domestic production (D) while import demand depends on relative prices (P^d/P^m) by another CES.

$$(13) \quad Q_i = a_i^c \left[\delta_i M_i^{-p_i^c} + (1 - \delta_i) D_i^{-p_i^c} \right]^{\frac{1}{p_i^c}}$$

$$(14) \quad M_i = D_i \left[\frac{P_i^d \cdot \delta_i}{P_i^m (1 - \delta_i)} \right]^{\frac{1}{1 + p_i^c}}$$

The model allow to trade exports and imports at the sectoral level separately. The CET and CES function provide a continuum of sectoral tradability, which allow partial insulation of domestic prices from world prices. In developing countries the commonly found dichotomy between traded and nontraded goods in CGE is less realistic.

III.- INCOME EQUATIONS

These equations map the flow of value added to institutions and households, representing the interinstitutional flows in the SAM. The factor incomes (Y^F) are distributed to capital Y_{cap} and labor households Y_{trab} (high, intermediate and low, urban and rural households).

$$(15) \quad Y_f^F = \sum_i WF_f \cdot FDSC_{if} \cdot wfdist_{if}$$

$$(16) \quad Y_{cap \in h}^H = Y_1^F - DEPREC \quad (Y_1^F = \text{capital factor income})$$

$$(17) \quad Y_{trab \in h}^H = \sum_{f \neq 1} Y_f^F$$

Government revenues (GR) are tariffs (TARIFF: Import Tariff Rights rate t^m), indirect taxes (INDTAX: General Value Tax and Consumption Selective Tax rate t^x) and income taxes (HHTAX: Direct Tax rate t^h).

$$(18) \quad TARIFF = \sum_i pw_i^m \cdot M_i \cdot t_i^m \cdot R$$

$$(19) \quad INDTAX = \sum_i P_i^x \cdot X_i \cdot t_i^x$$

$$(20) \quad HHTAX = \sum_h Y_h^H \cdot t_h^h \quad (h = \text{capital, labor})$$

$$(21) \quad GR = TARIFF + INDTAX + HHTAX$$

Total savings (SAVING) includes:

- financial depreciation (DEPREC) as a fixed proportion of capital,
- household savings (HHSAV) as a fixed saving propensity (mps) of net income,
- government savings (GOVSAV) as the difference of government income and expenditure, that if the government deficit (macro balance)
- and foreign savings (FSAV) in domestic currency (R is the exchange rate), that is the capital inflow required to balance the international payment embodying the current account (macro balance)

$$(22) \quad \mathbf{DEPREC} = \sum_i \mathbf{depr}^i \cdot \mathbf{P}_i^k \cdot \mathbf{FSDC}_{i1} \quad (\mathbf{FSDC}_{i1} = \mathbf{capital\ stock})$$

$$(23) \quad \mathbf{HHSAV} = \sum_h \mathbf{Y}_h^H \cdot (1 - \mathbf{t}_h^H) \cdot \mathbf{mps}_h$$

$$(24) \quad \mathbf{GOVSAV} = \mathbf{GR} - \sum_i \mathbf{P}_i^g \cdot \mathbf{GD}_i$$

$$(25) \quad \mathbf{SAVING} = \mathbf{HHSAV} + \mathbf{GOVSAV} + \mathbf{DEPREC} + \mathbf{FSAV} \cdot \mathbf{R}$$

IV.- DEMAND (EXPENDITURE) EQUATIONS

Private consumption (CD) is the sum of household demands measured by the household fixed consumption rate (1-mps) of the net household income [$Y^H(1-t^H)$], where β^H is the household expenditure share.

$$(26) \quad P_i^q CD_i = \sum_h [\beta_{ih}^H \cdot Y_h^H \cdot (1 - mps_h) \cdot (1 - t_h^H)]$$

The government consumption is a fixed share (β^G) of aggregate real spending (gdtot).

$$(27) \quad GD_i = \beta_i^G gdtot$$

Investment in inventories (DST) is calculate using fixed inventory investment ratios (dstr)

The fixed capital nominal investment (FXDINV) is the total investment (INVEST) less the inventory investment by sector. It is converted into real sectoral investment (DK) using investment nominal shares (kshr) which is one over all sectors. Using the capital composition matrix (b_{ij}) the investment by sector of destination (DK) is translated into final demand for investment goods (ID).

$$(28) \quad DST_i = dstr_i \cdot X_i$$

$$(29) \quad FXDINV = INVEST - \sum_i P_i^q \cdot DST_i$$

$$(30) \quad P_i^k \cdot DK_i = kshr_i \cdot FXDINV$$

$$(31) \quad ID_i = \sum_j b_{ij} \cdot DK_j$$

We define the nominal GDP in market prices (GDPVA) from the value-added side. Tariffs are added because intermediate input costs, which includes value imports inclusive of tariffs, were subtracted from P^v . In Nicaragua we had not export subsidies to consider in 1991.

$$(32) \quad GDPVA = \sum_i P_i^v \cdot X_i + IND TAX + TARIFF$$

Finally we define real GDP (RGDP) from the expenditure side.

$$(33) \quad RGDP = \sum_i (CD_i + GD_i + ID_i + DST_i + E_i - pw_i^m \cdot M_i \cdot R)$$

V.- EQUILIBRIUM (CLOSURE) EQUATIONS

In a CGE all endogenous variables are jointly determined, with prices adjusting to clear each market.

The market-clearing equilibrium in the product markets needs that the sectoral composite good supply (Q) must equal demand for intermediate inputs (INT) and final demand (CD , GD , ID , DST). We do not need additional equations for domestic output (X) because is the same as 36 when we add exports in both sides. Notice that the sectoral prices (equations 1 to 6) equilibrate Q , leaving P^d as the variable to adjust.

$$(34) \quad Q_i = INT_i + CD_i + GD_i + ID_i + DST_i$$

The market-clearing equilibrium in the factor markets needs that the total factor demand ($FDSC$) must equal the exogenous supplies of primary factors (fs). The factor prices (WF) equilibrate the factor markets. These are mobile between sectors.

$$(35) \quad \sum_i FDSC_{if} = fs_f$$

The next equation is the equilibrium in the balance of payments. If foreign savings ($FSAV$) are exogenous, the exchange rate (R) became the equilibrating variable, which in turn affect export and import prices (P^m and P^e), see equations 1 and 2. A real depreciation (change in export and import prices relative to domestic prices P^d) will result in an improvement of

external balance and a reduction in foreign savings. Other closures rules are likely. For example we can diminishes tariffs with fixed exchange rate and adjusting foreign savings and vice versa.

$$(36) \quad pw_i^m \cdot M_i = PW_i^e \cdot E_i + FSAV$$

The last closure rule, aggregate savings must equal total investment could have two alternatives: the “neoclassical closure”, a “saving-driven” model where total investment is determined by the government, the private and foreign savings (see page 86 above). This is useful to discuss public expenditure contraction policies (see 5.3.2).

The “Keynesian closure” is an “investment-driven” model, in which total investment is fixed and for example foreign savings is endogenous (see 5.3.1).

$$(37) \quad SAVING = INVEST$$

CHAPTER 2

THE EFFECTS OF MERGERS, ACQUISITIONS AND JOINT VENTURES BETWEEN US-MEXICAN FIRMS (1993-1994): AN EMPIRICAL ANALYSIS USING THE EVENT STUDY METHODOLOGY¹

I. INTRODUCTION

Although international Mergers and Joint Ventures have received growing academic interest, recent literature still lacks studies for the Mexican case. This is a preliminary study that intends to provide some general insights. It analyzes abnormal returns, wealth effects and transfers generated in Mexican Joint Ventures and Mergers with US partners.

We conduct an Event Study to measure the stock price response associated with the announcement of a Merger or a Joint Venture. In addition we analyze the aggregate wealth effects and transfer between the pairs of firms involved. Finally we make a cross-sectional analysis in order to examine the existence of investment opportunities, differences in abnormal returns due to the type of deal, size of the firms or country of origin.

¹ Published in "Inversiones y Finanzas", Bolsa Mexicana de Valores, Diciembre 1996, by Gerardo Dubcovsky and Benjamín García. We are grateful to Laura Starks, John D. Martin and Shilpa Mahajan Chandra

We find that the Mexican firms involved in Joint Ventures have larger abnormal returns even more than previous studies. In addition Mexican firm acquirers have positive and significant abnormal returns. Moreover divestitures of US companies generate a notable dollar wealth transfer to the Mexican acquirers.

Another important result is that in the Mexican case the abnormal returns exist for several days into the event period (-20 to 10). The event study methodology is unable to capture these prolonged effects because the information is diluted in the aggregate. Event studies are supported on the assumption of efficient markets. In the Mexican case the data shows a diagonal response to news generated, and much stronger for the event study period. This may be a signal of less efficient markets.

We detect an average of \$130 million dollars of wealth created in each pair of our sample. The more remarkable gains (more than \$100 million) happened when a US mega firm (market value more than \$9 billion) is involved

We attribute the abnormal returns with reference to NAFTA. The Mexican investors have a favorable perception of the possible outcomes. We can match these reactions on the efficiency theories of Mergers, i.e., investors' perception that operating synergies and

(University of Texas at Austin) for providing helpful comments, and to Juana Benitez (ITESM-CCM) for technical support.

strategic realignment of firms will generate positive net present value. On the other hand US investors seem quite skeptical of Mexican prospects. Their attitude may be qualified as one of "caution."

Finally the cross-sectional analysis shows significant effects on abnormal return due to size of firms, country of origin and type of agreement but none due to Tobin's q .

The rest of the paper is organized as follows. Section II gives some generalities of 1993-1994 US-Mexican activity and reviews the recent literature of International cooperatives' linkages. Section III describes the data and methodology. Section IV presents and interprets the findings, and finally Section V offers some concluding remarks.

II. MERGERS, ACQUISITIONS AND JOINT VENTURES

1. Generalities of 1993-1994 activity

Following NAFTA (the North American Free Trade Agreement) Mexican and US firms have increased their dealings both in numbers as well as in size of the deal.

Mexican acquisitions in the US have historically been extremely rare. And those deals that were made were mostly of small size. Nevertheless, under NAFTA, Mexican companies have started to establish themselves as 'acquirers' in the United States. For instance the combined purchase prices of only three deals (acquisitions Dina for Motorcoach, Synkro for Kayser-Roth and Cemex for Lafarge) exceeded 0.7 billion dollars.

On the other hand, American firms are increasingly looking to foreign markets for geographical diversification and, in many cases, for strategic design and growth in industries when domestic markets have matured. Such firms are viewing Mexico closely for expanding operations in a wide variety of industries, including telecommunications, steel, consumer products, brewing, auto parts, publishing, insurance, etc. While US firms have been investing in the Mexican economy for several years, Mexico has become even more attractive to US buyers since 1993.

The data shows that of all overseas countries attracting US firms for M&A proposals, in terms of total dollar value during 1993 and 1994, Mexico is second (\$1.8 billion) and sixth

(\$700 million) respectively. With regard to the number of deals, Mexico is seventh for both years (see Exhibits 1 and 2).

EXHIBIT 1

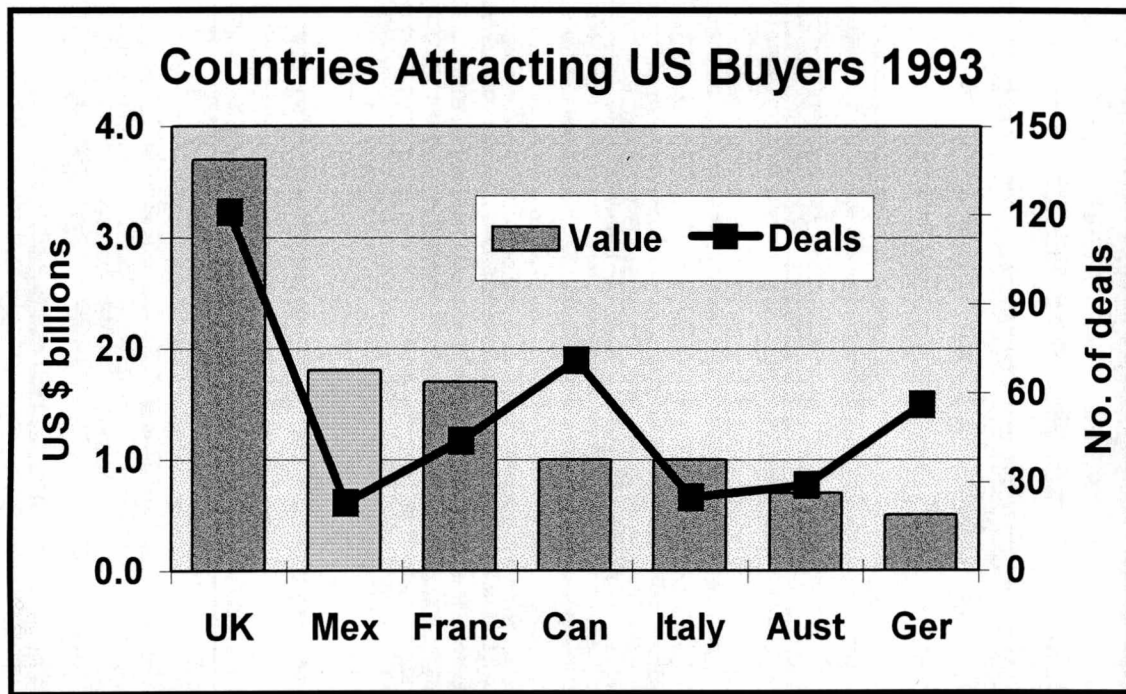
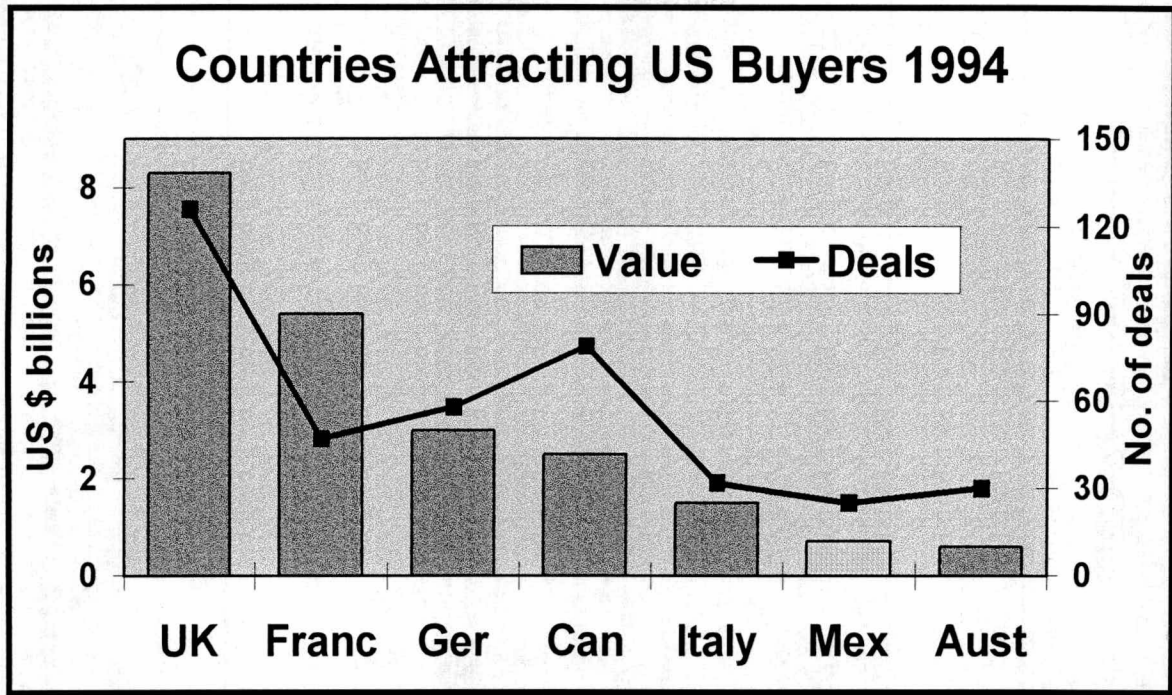


EXHIBIT 2



Most US ventures into Mexico have been either as modest-sized acquisitions purchases of partial interests in large companies, or joint ventures. Activity during 1993 and 1994 was marked by caution and strategic design, with some large American companies buying stakes in big Mexican firms in the process of constituting what were strategic agreements. In the coming years more M&A and Joint Venture deal making are expected due to NAFTA process that contemplates a gradual relaxation of the Mexican government limits on foreign investment. Therefore it is still too early to predict the form or pace of future Joint Venture and Merger activity, until firmer policies to implement the basic treaties are put in place and become operational.

2. International cooperative linkages

The cooperative linkages among firms could be seen as a continuum between a “spot contract at one end of the spectrum and a merger at the other.” Joint ventures are like partial mergers that create a “separate legal entity in which each participating firm holds an ownership interest while the partners remain independent. This contrasts with a merger in which one of the parties to the merger disappears and the agreement is intended to be permanent”² while Joint Ventures, on the other hand, usually have a finite lifespan. The participants in a Joint Venture are partners rather than an acquirer and a target of a merger.

Different reasons for going “international” have been provided. Weston, Chung and Hoag (1990, p.425-433) give ten of them: (1) market growth; (2) technology exploitation; (3) product differentiation; (4) government policy circumvention; (5) exchange rate risk reduction; (6) political and economic stability; (7) cheaper labor cost and/or more efficient labor; (8) following clients; (9) business diversification; and (10) seeking resources.

Some authors like Cheng and Chan (1995, p. 638) stress the business diversification and technology exploitation as the more important issues in international acquisitions. They think many international takeovers are motivated by the possible exploitation of existing home-

² Fröhls et al (1995) p.1. The authors distinguish Joint Ventures of consortiums, where the participants share risks in a project without creating a separately organization under the control of a joint entity. The consortiums are between the spot contracts and the Joint Ventures in the continuum.

based ownership and internalization advantages and matching these to home based location advantages. Caves (1982) concludes that vertical international takeovers internalize a market for intermediate products, while horizontal international takeovers internalize markets for intangible assets. In this sense, international acquisitions may generate wealth effects. Reviewing the reasons for US-Mexican firms we believe that these are plausible causes for increased Merger and Joint Venture activity.

There are six main difficulties in the international area: (1) different currency denominations, (2) economic and legal ramifications, (3) language differences, (4) cultural differences, (5) role of governments and (6) political risk. The latter was classified by O'Connor and Bueno (1990) in protectionism and regulation, discrimination against foreign firms, expropriation and war and civil disorders. These difficulties may generate the failure of cross-border mergers. A recent publication of Business Week contains a study by McKinsey&Co pointing out that nearly 40% of mergers end in total failure. Among the reasons they emphasize: foreign acquirers paying more for targets than domestic buyers would, differences of cultures that aggravate the integration of the management teams and finally misperceptions about the target's home market³.

Mexico is a good example of political risk. The internal policies heavily influence the stock market, and the instability of the globalization process certainly distorts the stock prices.

³ Business Week (1995) "The world is not always your oyster", October 30. p. 133-134

Thus the event study has serious problems for showing wealth effects when the international agreement is done in periods of uncertainty like early 1994 when Chiapas conflict broke out.

The findings of wealth effects are diverse and contradictory in recent literature⁴. Firms undertaking mergers or joint ventures seek to maximize value for their shareholders, which, in turn, imply that unanticipated announcements should be associated with increases in the market price of their common stock. In the Merger literature, we get high abnormal returns for target firms and flat (if no negative) for the acquirer group. For example Cheng and Chan (1995) find a 3-day cumulative average of 21% abnormal return (centered in the announcement day), on a sample of 70 international takeovers among firms of 13 countries, but with a minimum price paid of \$100 million during the period 1985-1990. For International Joint Ventures, Fröhl et al. (1995) find positive abnormal returns on the announcement day for the entire sample, 0.68%, but with a considerable disparity. The emerging market sample produces significant positive abnormal returns (1.36%) while the industrialized market sample produces insignificant ones. An interesting insight is that they differentiate among countries with respect to market size and maturity of product and market. In the special case of China the abnormal returns rise to 2.05%⁵. We expect in our study an intermediate response between China and Western Europe due to our above considerations.

⁴ See Cheng and Chan (1995) for International takeovers and Fröhls, Keown, McNabb and Martin (1995) for International Joint Ventures.

⁵ The authors use a 320 sample of Eastern and Western Europe and China for 1987-1992 period.

3. The Mexican Stock Market

Under the hypothesis of efficient markets, vertical jumps are rather expected when information is generated. The observation of diagonal trends during some days around the announcement day may be a signal of less efficient markets. The rules of disclosure in the US are guided to improve that efficiency. In the Mexican Stock Market, there are no clear disclosure rules for mergers and acquisitions. Usually the information is available before the registration. In such a situation rumors may affect market movements and private information becomes valuable, which means there might be room for the misuse of privileged information⁶. In this case event study will not be able to capture all the abnormal returns on a specific announcement day or close to it. There are no previous studies of the prices' response to M&A or Joint Ventures announces for the Mexican case.

⁶ In the case of banking privatization, Santillán (1993) find some evidence of “insider’s activity as a consequence of the lack of insider’s trading records”

III. DATA AND METHODOLOGY

1. Sample

To obtain the sample of Mexican and US firms undertaking international Joint Ventures or Mergers, we search in Lexis/Nexis for the announcement during 1993-1994 periods. The two-years sample period coincides with the negotiations and early implementation of NAFTA. We identified 48 announcements (out of 50 reported by Merger&Acquisitions, see appendix), which appear in PR Newswire and Reuters as well as in the Wall Street Journal. For the latter we take the day before the publication as the announcement date. We choose our sample of firms on the basis of the following criteria:

- a) Firms on New York Stock Exchange, AMEX, NASDAQ or Bolsa Mexicana de Valores (Stock Exchange).
- b) Firms in unregulated industries or in industries in the process of deregulation.
- c) We disregard Consortiums.

We faced some difficulties in getting data for firms that are international subsidiaries or have changed their CUSIP number. Thus the final sample of US firms is 35. On the other hand, of all the Mexican firms only 20 are traded on the exchange. Two of them are not included because there was no data around the announcement date, leaving 18 firms for the whole period. Finally our sample consists of 35 US firms, 18 Mexican firms, of which we were able

to find 17 pairs in both countries. This represent 70% and 34% of the total population of US and Mexican firms involved respectively.

This final sample is subdivided into three sub samples as Joint Venture, Target or Acquirer (mergers, acquisitions or divestitures) firms. The divisions are shown in Table 1.

TABLE 1

	Joint Venture	Acquirer	Target	Total
Mexican Firms	8	5	5	18
US firms	17	13	5	35
Total	25	18	10	53

See appendix III

The daily stock and market returns are obtained from the CRSP files for US firms. In order to calculate the Tobins'q and wealth effects, the stock prices, shares outstanding, assets and equity book value are obtained from COMPUSTAT data. The same data are achieved, in the case of Mexican firms, from Infosel (data base of the Mexican Stock Exchange) and "Anuarios del Banco de Mexico."

We recognize that our sample size is too small to reach any definite conclusions. To measure wealth effects and for the regression analysis a much larger sample is need. However this work may be considered as a preliminary step towards future research.

2. Methodology

We use the Event Study⁷ procedure similar to that described in Dodd and Warner (1983) to measure the stock price response associated with the announcement of a Merger or a Joint Venture. We estimated the abnormal performance for each firm using the one-factor market model as an approximation of the expected return generating process. We define the announcement-trading day as day 0, and the event study period as -20 to +10. The estimation interval for the market model begins in day -170 and ends with day -21. The abnormal returns for the event period are the difference in an observed return and its corresponding expected return. We also tested the significance of the returns.

In the Mexican case two problems should be solved: a) the selection of the market index and b) the “thin trade” problem.

a) The market index.

The selection of a market index is important because it affects the ability of the market model to assess abnormal returns. We select the IPC (the official index of the Mexican stock exchange) consisting on a value-weighted sample of stocks.

⁷ See the appendix II for further methodology details

The composition of the index is periodically revised on the basis of high liquidity in number of shares and total value relative to the value of the whole sample. The problem in choosing this index is the bias that Telmex stock price generates in the weights' structure. However because of the range of firms belonging to different industries in the Mexican sample of Mergers and Joint Ventures, the use of IPC is appropriate. It might be noted that the IPC is stationary for the period 1992-1994 in the logs of the first differences. However the IPC shows autocorrelation of first order. Thus we adjust the t-statistics (see methodology in Appendix II).

b) The “thin trade”

A major problem is generated by the “thin trade” i.e. stocks scarcely traded. The market model yields β 's estimate non significant and biased. In Table 2 we show the thin trading index, the percentage of days in which a stock was not traded by the number of trading days (150 in this case since -170 to -21).

TABLE 2**Thin index: Percentage of non-trading to total days**

FIRM	Thin index	FIRM	Thin index
Moderna	10%	Abaco	78%
Banacci	11%	Televisa	12%
Cifra	10%	Parras	100%
Bancomer	12%	Femsa	13%
Peñoles	46%	Ahmsa	79%
Invermexico	90%	Iusacell	73%
Cemex	5%	Alfa	18%
DINA	34%	Synkro	70%

There are two alternatives to overcome this problem. The first one is the use of weekly or monthly data. The problem is that the informational measure is more imprecise. The other alternative is to correct the problem using an available technique. We select the Scholes and Williams (1977) technique. The consistent estimator for β is assessed using the following formula.

$$\beta_{\text{THIN}} = \frac{\beta_{-1} + \beta_0 + \beta_{+1}}{1 + 2\rho_{m, m-1}}$$

where β_i is the calculated regression line slope for market return, i =lagged(-1), current (0) and advanced (+1), and $\rho_{m, m-1}$ is the correlation between normal and lagged series of market returns. Finally β_{THIN} (the intercept in the regression line) is calculated using the β_{THIN} in the market model.

IV. RESULTS

1. Abnormal returns

The methodology of the event study is applied to the sample of Mexican and US firms. First, we work on Mexican and US firms as separate groups trying to evaluate the abnormal returns. Table 3 shows the results for Mexican firms. It can be seen that there are statistically significant abnormal returns for two days after the announcement day (0). This result contrasts with the aggregate of US firms that do not show any significant abnormal returns.

TABLE 3
Total Sample

<i>Day</i>	<i>Abn.</i>	<i>SIGMA</i>	<i>T-STAT</i>
MEXICAN FIRMS			
0	0.19%	0.03331	0.24606
1	1.44%	0.02538	2.40723
2	1.75%	0.02772	2.67276
US FIRMS			
0	-0.18%	0.0157	-0.007

When the analysis is done by subdivisions in the case of Joint Ventures group, the Mexican firms have larger abnormal returns. The gains are statistically significant two days after the announcement date (see table 4).

TABLE 4
MEXICAN FIRM JOINT VENTURES

DAY	AB-RETURN	SIGMA	T-STAT
0	-0.57%	0.031589	-0.51
1	2.25%	0.030631	2.48
2	1.21%	0.016176	2.41

This unexpected highly positive **stock price reactions in the Mexican case are even greater than those found by Fröhls et al. (1995) in the cases of China⁸ and Eastern Europe.** Moreover the Joint Venture group of Mexican firms exhibits abnormal returns for several days before and after the announcement day⁹ (see Appendix IVa). We interpret that these abnormal returns may be due to the NAFTA process, that is Mexican investors have a favorable perception of the possible outcomes.

⁸ See footnote 5 above

⁹ It is essential to mention here, that this result is highly sensitive to jumps in the stock price of one firm. Since the total sample for Mexican Joint Ventures is 8 firms (see Table 1) the 22.1% drop in the stock price of the firm Ahmsa on days -5 to 0 introduces a down bias in the results of Table 4.

For the US group, the 17 firms involved in Joint Ventures do not have any significant abnormal returns (see Appendix IVb and Table 5). It may be a signal that US investors are quite cautious about NAFTA process and Mexican investments¹⁰.

TABLE 5
US FIRM JOINT VENTURES

DAY	AB-RETURN	SIGMA	T-STAT
0	-0.18%	0.015763	-0.007
1	-0.15%	0.01934	-0.006
2	-0.24%	0.016445	-0.010

For the Merger and acquisitions group, the results show that **Mexican firm acquirers have positive abnormal returns two days before and two days after the announcement date** (see Appendix IVc and Table 6). Moreover in spite of the 11.28% drop in Dina stock price on days -1 and 0, **the cumulating abnormal returns for -2 to 2 are 1.27%** (t = 2.84, significant to 5% level). Without Dina this effect would be even great¹¹. These results are contrary to those of past studies, wherein acquiring firms show little or no positive abnormal returns. This could again be interpreted as a true response of Mexican investors to NAFTA. These reactions support the efficiency theories of Mergers, i.e., investor perception that operating synergies and strategic realignment of firms will generate positive net present value.

¹⁰ See Mergers & Acquisitions, May-June 1994, page 7 -8

¹¹ In addition Exhibit 3 c shows again the sensitivity "small sample" effect due to Synkro stock price fall of 11.6% on days -6 to -4.

TABLE 6
MEXICAN FIRM ACQUIRERS

DAY	AB-RETURNS	SIGMA	T-STAT
-2	2.79%	0.02778	2.64**
-1	-0.25%	0.029094	-0.18
0	-0.63%	0.039064	-0.36
1	1.45%	0.023029	1.403122
2	3.75%	0.037972	2.61**

(**) Statistically significant at 5% percent level

We also find some abnormal returns on US acquirer firms taking place at the announcement date. This is greater than the normal US case but less significant as compared to the Mexican case (See Appendix IVd and Table 7). US investors perceive acquisitions in Mexico by US firms more positively than joint ventures between Mexican and US firms.

TABLE 7

US FIRM ACQUIRERS

DAY	AB-RETURNS	SIGMA	T-STAT
2	-0.16%	0.017182	-0.33
1	0.28%	0.015731	0.64
0	0.65%	0.014024	1.78*
-1	0.16%	0.021395	0.27
-2	-0.45%	0.016927	-0.95

(*) Significant at 10%

The results for the third group of target firms (see Appendix IVe and f and Tables 8 and 9) indicate that, on average, the announcement is associated with positive stock price reactions but much lesser than those found in previous studies. Moreover these results are similar in magnitude to those for the Joint Ventures and Acquirers group.

TABLE 8

MEXICAN FIRM TARGETS

DAY	AB-RETURN	SIGMA	T-STAT
0	2.24%	0.017031	2.94
1	0.14%	0.003534	0.87

TABLE 9

US FIRM TARGETS

DAY	AB-RETURN	SIGMA	T-STAT
------------	------------------	--------------	---------------

0	4.62%	0.047511	2.77
1	-2.10%	0.006438	-7.29

The above results indicate that the announcements by US firms of Joint Ventures and Mergers with Mexican Firms are associated with significant stock price movements. The reaction tends to be more pronouncing for the Mexican firms.

Finally when the event study is done on individual firms, we find a remarkable outcome. The reaction in the Mexican financial market is stronger but slower than in US financial markets (Table 10 shows CAR for some Mexican firms).

TABLE 10
SELECTED CUMULATIVE ABNORMAL RETURNS

FIRM	DAYS	CAR	Ttest
LA MODERNA	(-9,-2)	11.74%	(2.30)
IUSACELL	(0,8)	15.25%	(3.07)
CEMEX-B	(-6,0)	10.68%	(4.37)
DINA-ADR	(-16,2)	27.77%	(3.03)
SYNKRO-B	(-2,4)	24.7%	(4.57)
FEMSA	(-2,2)	12.3%	(2.84)
ALFA	(-2,1)	7.6%	(3.68)

That means the abnormal returns are present in several days into the event period (-20,10). Thus CAR increases in time. When the firms are aggregated in order to make a sample analysis this peculiar situation is diluted because of discrepancy in dates among abnormal

returns. Therefore in the aggregation we add abnormal returns with strong statistical differences with the same weight. The total result hides the individual firm stock price reaction.

The event study methodology is unable to capture these prolonged effects because of the assumption of efficient markets. In the Mexican case the data shows a diagonal response to news generated, and much stronger for the event study period. These results might be attributed to a lesser efficient market than in the US case, lack of clear regulations for mergers and Joint Ventures, and overall a weak monitoring activity of managerial performance. In any case event study methodology catches the global effect, but more specific methodology is required to complement and capture these insights.

We emphasize that the sample is not large enough to make forceful conclusions. It is necessary to extend the sample, by including other international agreements and the national activity in Mergers, Acquisitions and Joint Venture areas within Mexico.

2. Dollar wealth effect and wealth transfers

We calculated the wealth effect in dollars for each of the sample partners. We are interested not only in the net wealth created (destroyed) by each of the partners but also whether wealth

transfers between partners happened. Is there any relationship between the type of cooperative venture (Joint venture, merger, divestiture, etc.), the size of the firms and wealth created and transfer?

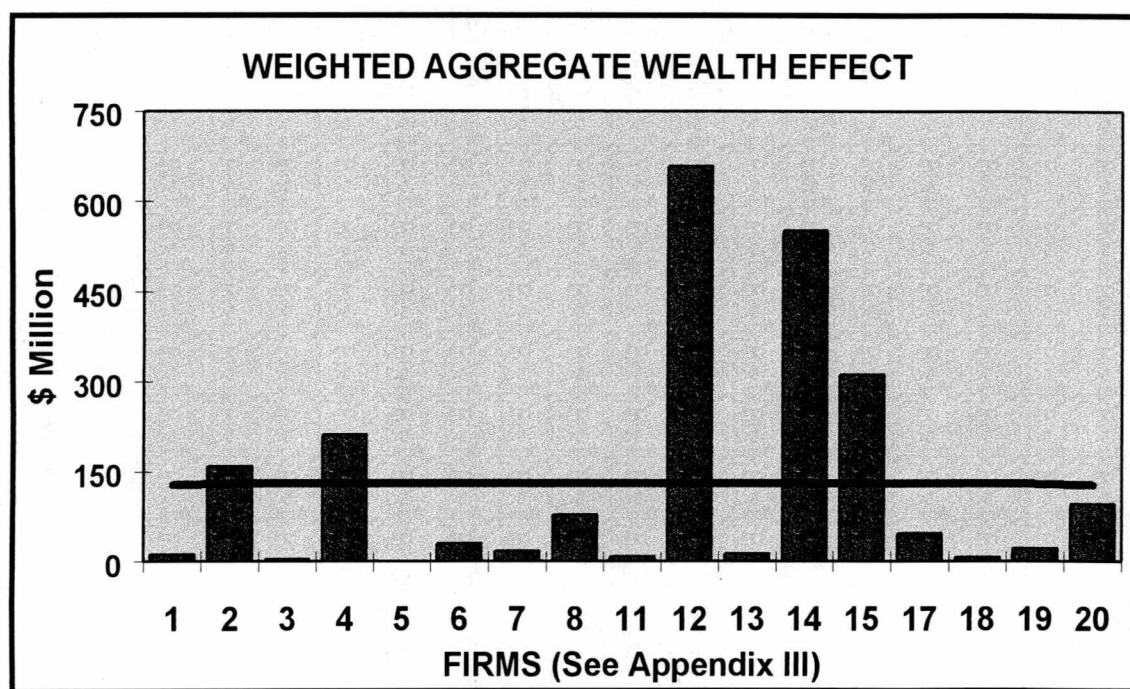
In order to test this hypothesis we estimated an average weighted dollar wealth effect for each partner¹². For the Mexican firms we use the monthly exchange rate (close) reported by the Central Bank to value the firm. The Mexican Stock Exchange annually reports the shares outstanding. We use the December shares outstanding for mergers or joint ventures occurred between the former October to next September. Finally we get the stock price on the -22 of the date of announcement day. The weights used were the ratio of the market value of the firm's shares divided by the sum of the market values of both firms.

We find an average of \$130 million dollars of wealth created in our sample. Only one merger has negative effects. We classify the firms in 3 categories: mega (more than \$9 billion), big (from \$1 to \$6 billion) and medium (less than \$1 billion). In the US side, 7 companies are mega, 6 big and 4 medium. In the Mexican one 4 are mega, 7 are big and 4 are medium. The more remarkable gains (more than \$100 million) happened when a US mega is involved. In Exhibit 3 we see these cases: strategic joint ventures in telecommunications with MCI (2) - Banacci and GTE (4) - Bancomer. Then we get the two biggest dollar wealth effect, more

¹² The total dollar effect for each firm = share price times shares outstanding times abnormal return. We use the ratio value of the firm to total value of the partners as the weight when calculating the average weighted dollar wealth effect.

than half billion each, the joint venture Tele-Communications (TCI) and Mexican television giant Televisa (12) forming a new cable company and the Coca-Cola (14) agreement to buy 30% of the FEMSA shares. Finally we have the purchase of 7.9 percent interest from Philip Morris (15) in Fomento Economico Mexicano, S.A. (FEMSA).

EXHIBIT 3

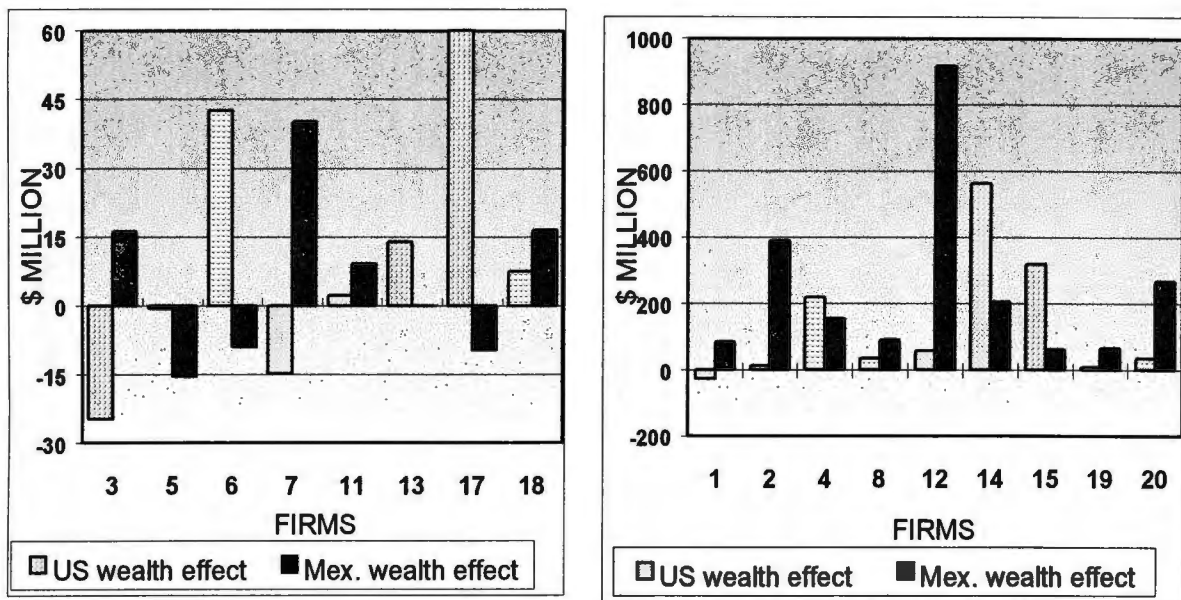


Note: the number of pair of firms in the exhibit match exactly with the numbers in the Appendix III. The bold line represents the US\$130 million average.

There are no any clear dollar wealth transfers seen, except when a US mega is involved we observe net gains for both partners. All the transfers, as shown in Exhibit 4, occurred with the involvement of US-Mexican biggest firms. Three of them are joint ventures and the other two are mergers with the Mexican firms as acquirers. Interestingly in the latter, divestitures of US companies generate a notable dollar wealth transfer to the Mexican acquirers Moderna (1)

buying Asgrow from Upjohn and Cemex (7) acquiring a 52 percent interest in Parker Lafarge.

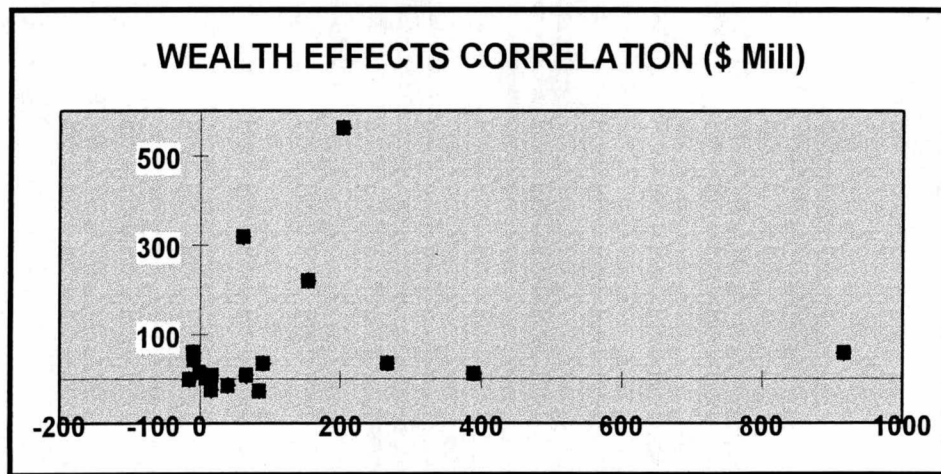
**EXHIBIT 4
WEALTH TRANSFERS**



Note: the number of pair of firms in the exhibit match exactly with the numbers in the Appendix III

Finally we cannot identify any correlation between the respective dollar wealth effect on the partners. The regression is not significant with $F=0.17$ (0.69) and coefficient 0.15 (0.41). The Exhibit 5 shows these results:

EXHIBIT 5



In the next section we make a cross-sectional analysis in order to clarify some patterns the wealth effect methodology does not allow to clearly state: existence of investment opportunities, differences in abnormal returns due to the type of deal, size of the firms or country of origin.

3. Cross-sectional analysis

We use OLS regressors taking the abnormal returns (**AB**) as the dependent variable: in the US firms the abnormal return is as on the announcement date and in the Mexican firms is the

cumulate abnormal returns from -2 to 2 in order to better capture the overall effect. The independent variables are:

a) Size of the firms: **MV**. It is the natural log of the firm market value on day -22. To calculate MV we use the procedure indicated above on '2) Dollar wealth effects'.

b) The investment opportunities are assessed using an approach to Tobin's "q"¹³: the ratio market to book value of the assets (**TQ**). For US firms we get the COMPUSTAT data, and for Mexican firms the Stock Exchange annual reports.

c) Type of agreement: we use a dummy variable that is one for mergers and zero for Joint Ventures (**DTY**). In addition we use a second dummy variable (**DTY2**) to differentiate acquirer from target firms in the merger case.

¹³ We use the approach suggested by Chung and Pruitt (1994) and Perfect and Wiles (1994)

d) Country of origin: **DCO**. We use a dummy variable that is one for Mexican firms and zero for US firms.

Since the model shown the presence of heteroskedasticity, we corrected using White's Heteroskedasticity-Consistent Covariance Matrix (White, 1980). All the variables except TQ (t-stat: -0.28) were significant in the regression. We eliminate TQ and accordingly the final model and results are:

$$\begin{array}{ccccccc}
 \text{AB} & = & \beta_0 & + & \beta_1 & \text{MV} & + & \beta_2 & \text{DTY} & + & \beta_3 & \text{DCO} & + & \varepsilon \\
 & & 0.049^{**} & & -0.0068^{**} & & & 0.0035^* & & & 0.0038^{**} & & & \\
 & & (2.25) & & (-2.20) & & & (1.99) & & & (2.08) & & &
 \end{array}$$

** Is significant at 5%. * Is significant at 6%.

R-squared: 26% Prob(F-statistic): 0.0018 DW: 1.98

As expected β_1 is negative, that is the greater the size of the firm the less the abnormal return. However as shown in IV.2 above, the total dollar value is positively related with the size of the firm offsetting the negative coefficient.

The β_2 coefficient is significant and positive indicating that mergers have slightly high abnormal returns than joint ventures (0.35% in average). The results with DTY2 (not

reported here) are similar denoting that the effect of target and acquirers are not significantly different, supporting the results in IV.2 (see above).

The β_3 is significant showing that Mexican firms exhibit higher abnormal returns than US firms (0.38% in average).

Finally the Tobin's q was no significant (see footnote 13 above). We can figure out nothing strong, because of the small size of the sample.

In conclusion the cross-sectional analysis shows that: (1) abnormal returns are negative correlated with the size of the firm; (2) mergers have slightly high abnormal returns than joint ventures; (3) Mexican abnormal stock returns are higher than US ones for the whole sample and data..

V. CONCLUDING REMARKS

There are no previous studies of the prices' response to M&A or Joint Ventures announces for the Mexican case. Therefore this is a preliminary study that intends to detect general insights. It analyses abnormal returns, wealth effects and transfers generated in Mergers, Acquisitions and Joint Ventures of Mexican firms with US partners.

We get some interesting results:

1) For Mexican firms, we get abnormal returns with statistical significance during two days after the announcement day (0) (1.44% and 1.75% on days 1 and 2 respectively). In contrast, US firms do not present any significant abnormal returns.

2) In the case of Joint Ventures the Mexican firms have larger abnormal returns even more than previous studies. The gains are statistically significant two days after of the announcement date (2.21% on day one and 1.25% on the day 2). Again for the US group, the 17 companies involved in Joint Ventures do not have any significant results.

3) For Merger and acquisitions, the results surprisingly show that Mexican firm acquirers have positive and significant abnormal returns two days before and two days after the announcement date and a 1.27% cumulate abnormal returns for -2 to 2. We also find some

abnormal returns for US acquirer firms on the date of the announcement (0.65%). These are however less significant than in the Mexican case.

4) For the group of target firms, both Mexican (2.24% on day zero) and US firms (4.62% and -2.1% on days 1 and 2 respectively) have significant abnormal returns; however less than those found in previous studies.

5) We find that in the Mexican case abnormal returns persist for several days into the event period (-20,10). Thus CAR increases in time but not simultaneously. The event study methodology is unable to capture these prolonged effects because the information is diluted in the aggregate. Event studies are supported on the assumption of efficient markets. In the Mexican case the data shows a diagonal response to news generated, and much stronger for the event study period.

6) We find an average of \$130 million dollars of wealth created in each pair of our sample. Only one merger has negative effects. The more remarkable gains (more than \$100 million) happened when a US mega (market value more than \$9 billion) is involved. There are no clear dollar wealth transfers seen, except when a US mega is involved we observe net gains for both partners. Interestingly in the latter, divestitures of US companies generate a notable dollar wealth transfer to the Mexican acquirers. Finally we cannot identify any correlation between the respective dollar wealth effects on the partners.

7) In the cross-sectional analysis we find that abnormal returns are negative correlated with the size of the firm, mergers have slightly high abnormal returns than joint ventures, and Mexican abnormal stock returns are higher than US ones for the whole sample and data. It is necessary to review the non-existence effects due to Tobin's q .

8) The following are some insights arising from this study:

a) The observation of diagonal trends on Mexican abnormal returns during some days around the announcement day could be a signal of less efficient markets. If this is the case the event study will be weak in reflecting the abnormal returns on a specific announcement day or close to it. These results might be attributed to a less efficient market than the US, lack of clear regulations for Mergers and Joint Ventures, and overall a weak monitoring activity of managerial performance. In any case event study methodology catches the global effect, but more specific methodology is required to complement and capture these insights.

b) We interpret the abnormal returns with reference to NAFTA. The Mexican investors have a favorable perception of the possible outcomes. We can match these reactions on the efficiency theories of Mergers, i.e., investor perception that operating synergies and strategic realignment of firms will generate positive NPV. On the other hand US investors seem quite skeptical of Mexican prospects. Their attitude may be qualified as one of "caution".

c) The sample is not big enough to make forceful conclusions. It is necessary to extend the sample to other international agreements and the national activity in Mergers, Acquisitions and Joint Venture within Mexico.

d) It might be interesting to extend the study to involve the governance structure (as Fröhls et al. 1995) of the firm, i.e. to the shareholder-management alignment hypothesis.

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APPENDIX I

LS // Dependent Variable is AB

Number of observations: 53

White Heteroskedasticity-Consistent Standard Errors & Covariance

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.0485930	0.0215552	2.2543478	0.0287
MV	-0.0067640	0.0030691	-2.2039431	0.0323
DTY	0.0034910	0.0017528	1.9916186	0.0520
DCO	0.0038473	0.0018493	2.0804345	0.0427
TQ	-0.0010890	0.0063751	-0.1708208	0.8651

R-squared	0.262487	Mean of dependent var	0.003130
Adjusted R-squared	0.217333	S.D. of dependent var	0.007102
S.E. of regression	0.006283	Sum of squared resid	0.001934
Log likelihood	195.5811	F-statistic	5.813155
Durbin-Watson stat	1.975287	Prob(F-statistic)	0.001761

APPENDIX II: The Event Study Methodology¹⁴

We estimated the abnormal performance for each firm using the one-factor market model as an approximation of the expected return generating process. We define the announcement-trading day as day 0, and the event study period as -20 to +10. The estimation interval for the market model begins in day -170 and ends with day -21.

The abnormal return in event day t is the difference in an observed return and its corresponding expected return, i.e. the predicted errors of the market model.

$$AR_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt})$$

Where,

AR_{jt} = Abnormal Return of stock $j=1, \dots, N$ in event day $t=1, \dots, T$

R_{jt} = The rate of return on security j in event day t .

R_{mt} = The rate of return on the value weighted market portfolio in event day t .

β_j = Covariance (R_{jt} , R_{mt}) / Variance (R_{mt}), over the estimation interval

α_j = $E(R_{jt}) - \beta_j E(R_{mt})$, over the estimation interval.

¹⁴ See Dodd and Warner (1983)

Then we average the abnormal returns across firms for each of the event dates, eliminating extraneous effects on the security's individual returns. Thus for each trading event day t the average abnormal return (AAR_t) is defined as:

$$AAR_t = 1 / N_t \sum_{j=1}^{N_t} AR_{jt}$$

Where:

N_t = The number of firms with an abnormal return defined in day t .

The abnormal returns for each firm can be cumulated for various intervals of time over the event period. This cumulative average abnormal return (CAR_t , $t=1, \dots, U$) is defined as:

$$CAR_t = \sum AR_t$$

TEST THE STATISTICAL SIGNIFICANCE OF THE ABNORMAL RETURNS

We use two t-test: t for cross-sectional average abnormal returns and t_{car} for the cumulative abnormal returns.

To test the null hypothesis of zero average abnormal returns (AAR_t) in event day t , the following t-statistic is calculated:

$$t = \frac{AAR_t}{\sigma_t / \sqrt{N}}$$

Where t-stat assumed to be distributed as Student's t , and σ_t is estimated from the cross-section of abnormal returns on the announcement date ($t=0$).

$$\sigma_t = \sqrt{\frac{1}{N} \left[\sum_{j=1}^N (AR_{jt} - AAR_t)^2 \right]}$$

To test the null hypothesis of zero cumulate abnormal returns (CAR_t) in event period t , the following t-statistic is calculated:

$$t_{car} = \frac{CAR_t}{\sigma_{car}}$$

Where the variance (σ_{car}^2) takes into account the intertemporal correlation (see part 2.a)

$$\sigma_{\text{car}} = \sqrt{U} \sigma_t \left[1 + \frac{U}{T} + \frac{U(\sum R_{mt}/U - \bar{R}_m)^2}{\sum (R_{mt} - \bar{R}_m)^2} \right]^{1/2}$$

Where,

U = Accumulation period

T = Estimation period of length T

\bar{R}_m = Average market return during estimation period.

APPENDIX III: announcements

	ACQUIRER	ANNOUNCE DATE	STATUS	
1.	Asgrow Seed Co (USA) UPJOHN	Empresas La Moderna (MEX)	November 1, 1994	Divestiture
2.	Banacci (MEX)	MCI (USA)	January 25, 1994	Joint Venture
3.	Wal-Mart and Cifra (MEX)	Dillard Department Stores (USA)	January 7, 1994	joint venture
4.	GF Bancomer and VISA (MEX)	GTE Corp (USA)	September 27, 1994	joint venture
5.	Refmex of Industrias Penoles (MEX)	Indresco (USA)	June 13, 1994	Divestiture
6.	Grupo Financiero InverMexico (MEX)	Household International(USA)	July 19, 1994	joint venture
7.	Parker Lafarge (USA)	Cementos Mexicanos (CEMEX)	May 18, 1994	Divestiture
8.	Consortio G. Grupo Dina S.A. de C.V (MEX)	Motor Coach Industries International, Inc.	November 30, 1993	Merger
9.	Kayser-Roth Corp (USA)	Grupo Synkro (MEX)	November 1, 1993	Merger
10.	Grupo Mexico (MEX)	ASARCO (USA)	November 12, 1993	Merger
11.	Rodman & Renshaw Capital (USA)	Abaco Casa de Bolsa (MEX)	November 2, 1993	Merger
12.	Grupo Televisa (MEX)	Tele Communications Inc (TCI) (USA)	May 20, 1993	Merger
13.	Compania Industrial de Parras (MEX)	Cone Mills Corp (USA)	March 29, 1993	Merger
14.	Fomento Economico Mexicana (Femsa)	Coca-Cola Co (USA)	March 25, 1993	Merger
15.	Fomento Economico Mexicana (Femsa)	Philip Morris (USA)	December 3, 1992	Merger
16.	Grupo Modelo (MEX)	Anheuser-Busch (USA)	March 1, 1993	Merger
17.	Altos Hornos de Mexico SA	Inland Steel Industries Inc	May 25, 1994	joint venture
18.	Grupo Iusacell SA (MEX)	Sprint Corp	July 25, 1994	joint venture
19.	Grupo Industrial Alfa SA de CV	Shaw Industries Inc	October 1, 1994	joint venture
20.	Grupo Financiero Bancomer SA	NationsBank Corp	April 14, 1994	joint venture
21.	Mobilcom (MEX)	Nextel Communications	June 6, 1994	Merger

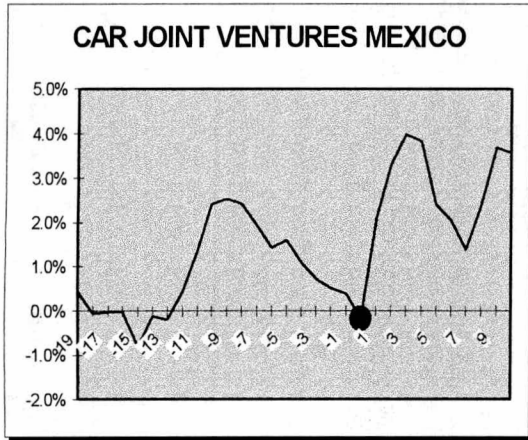
22. AXA's (Mexico) subsidiary Alimentos	Lee (Sara) Corp/ AXA	March 1, 1994	Joint Venture
23. ELECTROFORJADOS NACIONALES SA DE CV (MEX)	HARSCO CORP	November 1, 1993	Merger
24. Grupo Iusacell (MEX)	Bell Atlantic Corp	October 11, 1993	Merger
25. Pacific Star de Occidente (MEX)	Pillsbury Co (The)	September 1, 1993	Merger
26. Aceros Fortuna, S.A. de C.V (MEX)	Carpenter Technology Corporation	July 29, 1993	Merger
27. Asesores Kennedy Agentes de Seguros (MEX)	Alexander & Alexander Services	July 13, 1993	Merger
28. Arancia SA (MEX)	CPC International Inc	October 28, 1994	joint venture
29. Auto Todo of Mexico	Genuine Parts Co	September 7, 1994	joint venture
30. Ispat Mexicana SA	Wheeling Pittsburgh Corp's steel	July 5, 1994	joint venture
31. Grupo VideoVisa(MEX)	Handleman Co	June 2, 1994	joint venture
32. FINSA Grupo Arguelles of Mexico	Morrison Knudsen Corp	February 28, 1994	joint venture
33. Transportes de Nuevo Lardeo of Mexico	Roadway Services Inc	May 28, 1993	joint venture
34. Consorcio Larmo (MEX)	Durakon Industries Inc	March 22, 1993	joint venture
35. Grupo Industrial Durango	Temple-Inland Inc	November 6, 1992	joint venture
36. El Puerto de Liverpool (MEX)	Kmart Corp	December 21, 1992	joint venture
37. Geo New York Life (MEX)	New York Life Worldwide Developments	September 23, 1994	"plans to acquire majority interest in"
38. Valves and Pipe Fittings, NEC (MEX)	Kitz Corp of America	July 14, 1994	"plan joint venture" (in negotiation).
39. Del Monte Foods Corp (USA)	Group of Investors	June 27, 1994	"plans to acquire"
40. Cima (Mexico)	Acme Cleveland Corp's subsidiary Communications Technology Corp (USA)	November 19, 1993	Joint-Venture
41. Grupo Azteca (MEX)	National Broadcasting Co (NBC)	November 16, 1993	"plans to acquire interest in"

42. Ford Motor Company's Favosa S.A. de C.V.	Lear Seating Corporation, a subsidiary of Lear Holdings Inc	Agosto 23, 1993.	it had completed the previously announced purchase of most of
43. TAPETES AUTOMOTRICES MEXICANOS SA DE CV [TAMEX]	COLLINS & AIKMAN CORP (DOBLIN TEXTILES)	November 1, 1993	Completion Date: 11/01/93
44. VIRMAR TELECOMUNICACIONES SA DE CV (MEX)	AMERICAN TELEPHONE & TELEGRAPH CO	September 23., 1993	Mergers
45. Novaquim S.A. de C.V. (MEX)	Uniroyal Chemical Co	July 26, 1993	joint venture
46. Brockman & Schuh (MEX)	Johnson & Higgins	May 24, 1993	"agrees to acquire interest in (in negotiation).
47. Computec	Acer	Jun 14, 1994	joint venture
48. Baja Celular of Grupo Protexa (MEX)	Motorola (USA)	June 23, 1994	joint venture

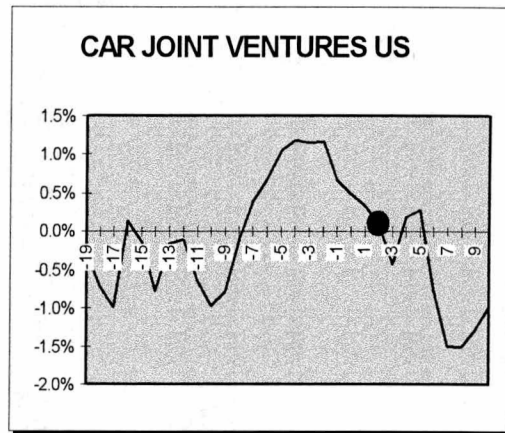
The sample is composed for 35 US firms and 18 Mexican firms.

APPENDIX IV: Cumulate Abnormal Return

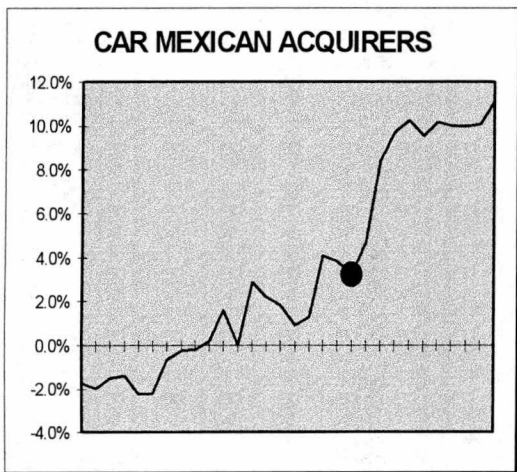
A)



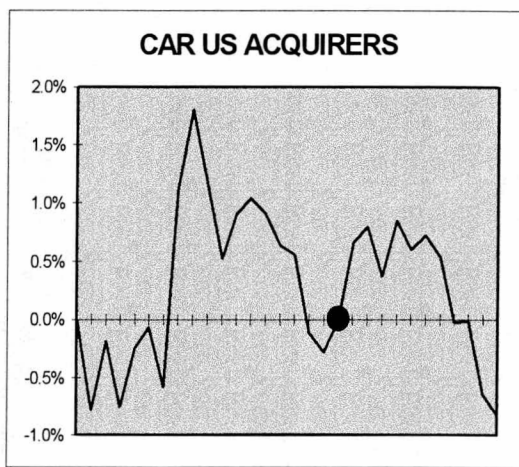
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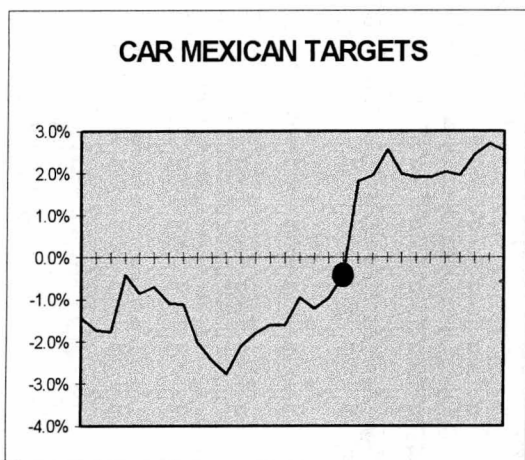
C)



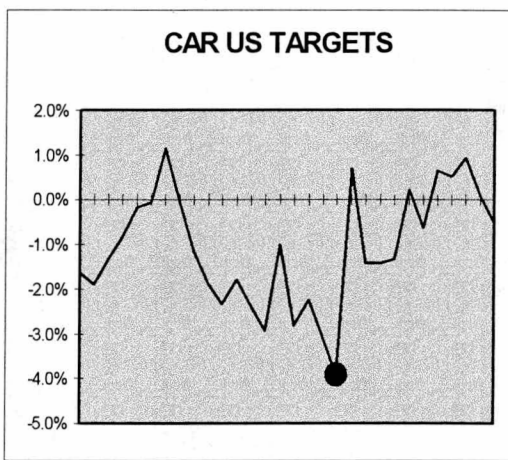
D)



E)



F)



CHAPTER 3

THE KALMAN FILTER IN THE EVENT-STUDY METHODOLOGY¹

I. INTRODUCTION

Financial analysts are often concerned with measuring the effect of an economic or financial event on the market value of a specific firm. The most common approach to assess the impact of a certain event on the firm performance is the event-study² (ES) analysis, which uses financial market data. In this methodology, the effect of an event will be related to the short-run returns of the assets available in the economy.

The literature in the event-study methodology is large and applications range in a wide variety of events and firms; for instance, mergers, alliances, joint ventures, acquisitions, new debt, new stock, splits, payment of dividends, new regulation, etc. See Thompson (1995), MacKinlay (1997), Cable and Holland (1999) for a comprehensive survey. The utility of the event study methodology is referred by Campbell, Lo and

¹ By Gerardo Dubcovsky and Francisco Venegas. We are grateful to Bernardo González-Arechiga, Jaime Díaz Tinoco, and José Carlos Ramírez Sánchez for helpful comments and suggestions. Needless to say, all errors and opinions remain responsibility of the authors

² From now we will use ES abbreviation for event-study

MacKinlay (1997) to the acceptance of the methodology by the U.S. Supreme Court for determining materiality in insider trading cases.

Even though there is not a unique structure of an ES, we may summarize the following main steps: 1) define the event of interest, 2) determine the event day and window, 3) select the firms, 4) define the normal and abnormal return, 5) estimate the parameters, 6) test for abnormal returns, 7) and provide interpretations of the results (Campbell et al 1997).

Since the pioneer paper of Dolley (1933) the level of sophistication of the ES analysis has increased. Important contribution to the theory and practice of event studies can be found in Ball and Brown (1968). In the seminal ES stock splits, Fama, E, L. Fisher, M Jensen and R.Roll (1969) formally developed the ES method, as we know today. Scholes and Williams (1977) extend it to the nonsynchronous technique; Brown and Warner (1980 and 1985) show the power and robustness for monthly, weekly and daily data. Finally Acharya (1993) formally introduced the conditional ES.

In the nineties we got several papers introducing ARCH (GARCH) models and time-varying betas in ES, like Schewert and Seguin (1990) in the US, Poon and Taylor (1992) in the UK, Koutmos, Lee and Theodossiou (1994) in international stock markets, Brockett, Chen and Garven (1998) in the US, Cable and Holland (2000) in UK, among others. They

want to deal with volatility persistence and the time-varying behavior of systematic risk. Other papers deal with partial anticipation of information like Acharya (1993) and Yoon and Starks (1995).

Traditional ES assumed constant systematic risk (beta) and variance through the pre- and/or post-event periods. These were extrapolated to the event window in order to detect the presence of abnormal returns. However Brown and Warner (1985) noticed that if the variance was underestimated, the test statistic would lead to rejection of the null hypothesis more frequently than it should. We might detect events where there are not. The opposite could happen if we overestimated the variance. Time-independent parameters and time-unvarying volatility are not good assumptions in emerging markets like Mexico, where high volatility and changes in volatility are more the rule than the exception.

Since late eighties, Mexico have experienced a deep economic structural change. The inward, import substitution, high government protected and regulated economy have been rapidly changed. The globalization process and the new outward orientation of the Mexican economy went deeper in the nineties: privatization of the government firms, bank system and telecommunications companies, trade opening, NAFTA, and high degree of capital mobility imply high return for investments, but high volatility³.

³ Mexico was a pioneer in the emerging markets finance globalization. In 1990 Mexico issued the first Brady Bond ; in 1991 Telmex was the first important ADR registered in the NYSE; in 1995 the Mexican peso was the first emerging future market operating in Chicago, and the IPC future also in 1996.

Even though much knowledge has been gained about the impact of corporate news announcements from domestic and foreign firms in Mexico, much still remains to be learned. There are five main works using ES methodology. Santillan (1992) studied the early nineties bank privatization announcement effect on stock returns. He found some evidence of “insider’s activity as a consequence of the lack of insider’s trading records” as well as an U-shape cumulate abnormal return around the event day. The same U-shape was found in Esteban (1997) who considered 40 strategic alliances in Mexico during 1989-1994. He endorsed this U-shape to negative information signaling or price adjustments to previous overpricing. Dubcovsky and Garcia (1996) analyzed the activity or mergers, acquisitions and joint ventures between US-Mexican firms in face of NAFTA, 1993-1994. They found diagonal trends in the event period attributed to lack of clear regulation in Mexico and an overall weak monitoring activity of managerial performance. They conclude that “event study methodology catches the global effect, but more specific methodology is required to complement and capture these insights.” Hensler et al (2000) examined the initial public offerings in Mexico during 1987-1993. They found much larger initial under pricing for banks than for no banks, even higher than those shown in other studies of international IPOs, attributable to a deliberate discount of the government in the bank privatization under conditions of policy risk. Finally Bhattacharya et al (2000) using a sample of Mexican corporate news announcements from 1994 to 1997 found nothing unusual about returns, volatility of returns, volume of trade or bid-ask spreads in the event window. The suggested

that “unrestricted insider trading causes prices to fully incorporate the information before its public release.” They conclude that “if prices do not react to news announcements, how does an econometrician date an event in an event study?” These contrasting results have a common methodology: modeling with time-independent parameters.

The growing economic importance of Latin American’s emerging markets characterized by singular institutional and regulatory frameworks provides an interesting environment to evaluate the effects of financial and economic events on the market value of firms. These markets exhibit high (expected) returns as well as high volatility, and little is known about their short and long-term effects. Even though a time-varying parameter formulation of the ES methodology seems to be more realistic, there are few attempts in the existing literature to extend such a methodology in this direction. Koutmos et al (1994) and Brocket et al (1998), among others, made use of an AR(1) to model β_t in the market model. However they do not employ this information to update parameters in the event window. Koutmos et al (1994) uses the time-varying information to measure volatility persistence in international markets, and Brocket et al (1998) to test individual firms effects due to the application of California’s Proposition 103.

In this paper, we extend the ES methodology into a richer dynamic environment by including time-varying parameters. Under the Bayesian framework, useful to update relevant information in a sequential learning mechanism, we use the Kalman filter to

consider time dependent parameters, and we choose the initial distribution by using an information theory framework.

The Kalman filter (KF), originally developed in control engineering, has been increasingly used in economics and finance. It was introduced by Kalman (1960), Kalman and Bucy (1961), and independently by Swerling (1959) and Stratonovich (1960). Some of its numerous applications in these fields can be appreciated in Athans (1974), Burmeister and Wall (1982), Burmeister, Wall and Hamilton (1986), Sargent (1989), Basar and Salmon (1989), Black, Fraser and Power (1992), Venegas-Martínez et al (1995), Gonzalez-Rivera, G. (1997), Groenewold and Fraser (1999), Nowman and Babbs (1999), Jochum (1999), Duan and Simonato (1999), Venegas-Martínez et al (1999), McKenzie, Brooks and Faff(2000), Priestley (2000), Cornelis (2000), among others.

Our approach in presenting the KF uses information theory which has been extensively applied in economics and finance; we mention, for instance, Theil, Scholes and Uribe (1965), Theil and Uribe (1965), Uribe, De Leeuw and Theil (1965), Cozzolino and Zahner (1973), Akaike (1981), Kapur (1990), Venegas-Martínez (1990), (1990a), (1990b) and (1993), and Venegas-Martínez et al (1995) and (1999). We start off the recursive procedure of the KF by determining, via information theory, an estimator of the initial distribution when there is information in terms of moments, and then we use Bayesian inference to state the updating process of the KF. We think that under this framework the

presentation is more attractive to financial analysts. It is worth pointing out that our approach to obtain the KF is simpler than those from Ho and Lee (1964), and Meinhold and Singpurwalla (1983).

The structure of this paper is as follows. In the next section, we present the most popular statistical models for measuring normal returns. In section 3, we briefly review the state-space models. In section 4, we extend the event-study analysis by including parameters that change with time, outlying the relationship between the Kalman filter with both information theory and Bayesian inference. In section 5, we provide a discussion about Kalman filtering, normal and abnormal returns, and testing hypothesis. Finally, in section 6, we give conclusions, acknowledge limitations, and make suggestions for further research.

II. STATISTICAL MODELS OF EVENT STUDIES

Event studies either (explicitly or implicitly) assume that markets are informationally efficient or they explicitly test for the informational efficiency. There are several models available in the literature to calculate the normal return of a given stock. These approaches can be grouped into two types, statistical and economic. In the former, there are statistical assumptions concerning the behavior of the asset returns. While, in the latter, there are assumptions on the behavior both economic agents and asset returns. In particular, in the statistical type it is customary to assume that asset returns are distributed multivariate normal independently. A number of the statistical models have been proposed for measuring normal returns; we briefly review two of the most popular statistical models in event studies: the constant-mean-return and the market models.

The estimation period of normal returns could be either before and/or after the event in question. There is a tradeoff in choosing the length of period: it should be long enough to get a reliable measure of the model's parameters but not so long to have time varying parameters. Also we need to consider whether the event itself might have altered the return process. In the case of daily returns, the estimation periods usually have between 60 and 300 days.

2.1. The constant-mean-return model (comparison period return model)

The constant-mean-return framework (see Brown and Warner 1980) was very popular in event-study analysis. Although the below framework is one of the models it turns out that the obtained results are similar to those from more sophisticated models (see, for instance, Brown and Warner, 1985). Let μ_i be the mean return for asset i . Let us define

$$\mathbf{R}_{it} = \mu_i + \varepsilon_{it}, \quad (2.1)$$

where R_{it} is the return in period t on the security i , and ε_{it} is white noise for each i , that is to say,

$$\mathbf{E}[\varepsilon_{it}] = 0, \quad \mathbf{Var}[\varepsilon_{it}] = \sigma_i^2. \quad (2.2)$$

Plainly, the (unconditional) mean and variance of R_{it} are given by

$$\mathbf{E}[\mathbf{R}_{it}] = \mu_i, \quad \mathbf{Var}[\mathbf{R}_{it}] = \sigma_i^2. \quad (2.3)$$

Finally, it is important to point out that with monthly data, the model can be applied to real returns or excess returns as well as nominal returns.

2.2. Market model (Single Index Model)

The market model relates the return of any give security to the return of market portfolio. The model's linear specification follows from the assumed joint normality of the asset returns. Specifically, for any stock i , we have

$$\mathbf{R}_{it} = \alpha_i + \mathbf{R}_{mt} \beta_i + \varepsilon_{it}, \quad (2.4)$$

where ε_{it} is taken as in (2.2). Here \mathbf{R}_{mt} is the return in period t on the market portfolio. The coefficients α_i , β_i and σ_i^2 are the relevant parameters of the model. Note that the standard linear regression assumptions apply to the market model. We are assuming stationarity in the parameters.

The market model improves in several aspects the constant-mean-return model. For instance, by removing the portion of the return that is related to variations in the market return, the variance of the abnormal return is reduced. This can lead to increased ability to detect event effects. The advantages from using the market model will depend upon the R^2 of the market-model regression. The higher the R^2 , the greater the variance reduction of the abnormal return, and the larger the gain. Therefore, in this paper we will focus on market model.

2.3. Abnormal returns (AR) and testing.

We define the announcement-trading day as day 0, and the event study period of interest or event window two or three days surrounding the event. However if the timing of the information is not known with certainty, or we are interested in capture other market's responses a longer period may be necessary. It is usual to consider from -20 to +10 or +20.

The abnormal return in event day t for firm i (AR_{it}) is the difference between an observed return and its corresponding expected return measured by one of the models described above. That is:

For the constant-mean-return model $AR_{it} = e_{it} = R_{it} - \mu_i.$ (2.5)

For the market model $AR_{it} = e_{it} = R_{it} - (\alpha_i + R_{mt} \beta_i).$ (2.6)

Then we average the AR_{it} across firms i in each day t of the event window (AAR_t) and test the null hypothesis of no reaction ($H_0, AAR_t = 0$), usually formulated in order to be rejected. Under the alternative hypothesis, the event is accepted to be significant to the pricing of the assets under consideration ($H_a, AAR_t \neq 0$). Depending of the prior expectation of the AAR_t we considered a one-tailed or a two-tailed test, $t = \frac{AAR_t}{\sqrt{\frac{\hat{VAR}_t}{N}}}$,

where VAR_{AAR}

$$\hat{\text{VAR}}_t[\text{AAR}_t] = \frac{1}{N} \sum_{i=1}^{N_t} [\text{AR}_{it} - \text{AAR}_t]^2 \quad (2.7)$$

Finally we may cumulate the average abnormal returns for periods t_1 to t_2 (CAR_{t_1,t_2})

surrounding the event day, testing again for no reaction, $t_{\text{CAR}} = \frac{\text{CAR}(\tau_1, \tau_2)}{\sqrt{\hat{\text{VAR}}_{\text{CAR}}}}$,

where adjusting for first-order autocorrelation in the abnormal returns, VAR_{CAR} (see Ruback 1982) is:

$$\hat{\text{VAR}}_{\text{CAR}(U)}(\tau_1, \tau_2) = U \hat{\text{VAR}}_t(\tau_1, \tau_2) \left[1 + \frac{U}{T} + \frac{U(\sum \text{R}_{mt} / U - \bar{\text{R}}_m)^2}{\sum (\text{R}_{mt} - \bar{\text{R}}_m)^2} \right], \quad (2.8)$$

$$\hat{\text{VAR}}_t(\tau_1, \tau_2) = \frac{1}{U} \sum_{t=\tau_1}^{\tau_2} [\text{AAR}_t - \overline{\text{AAR}}_U]^2, \quad (2.9)$$

where, U = Accumulation period from τ_1 to τ_2 , and T = Estimation period of length T .

III. THE STATE-SPACE REPRESENTATION

The structural time series models are regression models with time-dependent explanatory variables and time-varying parameters. The state-space representation is the form to deal with this kind of models while the KF is a recursive procedure for computing the optimal estimator of the state vector at time t when new observations become available. We can also extrapolate these elements into the future and the KF get the best estimate of the state at any point.

This section follows Venegas (1995); we briefly introduce the state-space representation or form and the measurement equations of a dynamic system. The multivariate case will be our focus. We assume that all vectors and matrices have consistent dimensions.

Let Y_1, Y_2, \dots, Y_t be a set of indirect measurements, from a polling system or a sample survey of an unobserved state variable β_t . The objective is to make inferences about β_t . We may think of Y_t and β_t as either scalars or vectors with dimensions which may be the same or different. The relationship between Y_t and β_t is specified by the measurement equation, sometimes also called the observation equation:

$$Y_t = X_t \beta_t + \varepsilon_t, \quad (3.1)$$

where, X_t is a matrix of known parameters, and the ε_t is the observation error distributed as $N(0, \Sigma_{\varepsilon t})$, with $\Sigma_{\varepsilon t}$ known. Since the variance changes over time we have, in general, a heteroskedastic error model. Notice that the main difference between the measurement equation and the conventional linear model is that in the former, the coefficient β_t changes with time.

The most popular dynamic extension of the error term in the conventional linear model states that

$$\begin{cases} Y_t = X_t \beta + \varepsilon_t, \\ \varepsilon_t = Z \varepsilon_{t-1} + \eta_t, \end{cases} \quad (3.2)$$

where Z is a matrix of known parameters, and β is distributed as $N(0, \Sigma_{\eta t})$. Notice that β and $\Sigma_{\eta t}$ are time invariant. The Kalman filter will not be concerned with the dynamics of the error term, ε_t , as in (3.2), but instead with the dynamics of the state variable, β_t in (3.1), this being the other essential difference from the conventional linear model. We suppose that the dynamic behavior of the state variable β_t is driven by a first order autoregressive process, that is,

$$\beta_t = \mu_{t-1} + Z_t \beta_{t-1} + \eta_{t-1},$$

where the drift μ_{t-1} is a vector of exogenous or predetermined variables, Z_t is a matrix of known parameters and $\eta_t \sim N(0, \Sigma_{\eta_t})$ with Σ_{η_t} known. Or even more generally,

$$\beta_t = \mu_{t-1} + Z_t \beta_{t-1} + L_t \mu_{t-1} + \eta_{t-1}, \quad (3.3)$$

where L_t is a known matrix that relates the control inputs, μ_{t-1} , to β_t . Equations (3.1) and (3.3) are known in the literature as the state-space representation of the dynamics of β_t . Throughout the paper, we shall assume that β_t , ε_t and η_t are independent random vectors, and $L_t = 0$. We might state nonlinear versions of (3.1) and (3.3), but this would not make any essential differences in the analysis.

IV. KALMAN FILTERING, INFORMATION THEORY, AND BAYESIAN INFERENCE

Once we get the model in a state space form, we can use important algorithms like the Kalman filter (KF). This is a recursive procedure which allow us to calculate the optimal estimator of the state vector at time t , based on information existing at that time. The KF makes possible the estimate of the state vector to be constantly updated. We could calculate recursively β_{it} , conditional on the information set at time t , from t_0 to T . The KF computes the means and covariance matrices of the conditional distributions, which are themselves normal. This optimal estimator minimizes the mean square error⁴. Finally the KF yields also the optimal estimator of the state vector in the next period, based on the information set available at that time, containing all the information needed to make optimal predictions of future values of the state.

Let $R_{i1}, R_{i2}, \dots, R_{it}$ be a set of returns of the i -th asset. The relationship between the return, R_{it} , and the time-varying coefficients, α_{it} and β_{it} , is specified by the following measurement or observation equation:

$$R_{it} = \alpha_{it} + R_{mt} \beta_{it} + \varepsilon_{it}, \quad (4.1)$$

⁴ Even when we drop the normality assumption, the KF gives an estimator which minimizes the mean square error in the class of all linear estimators (see Harvey, 1992, pp.162-165).

where R_{mt} is the market return and ε_{it} is the observation error distributed as $N(0, \sigma_i^2)$, with σ_i^2 known. Notice again that the main difference between the measurement equation and the market model is that, in the former, the coefficients α_{it} and β_{it} changes with time. Furthermore, we suppose that β_{it} is driven by a first order autoregressive process, that is,

$$\beta_{it} = z_{it} \beta_{i,t-1} + \eta_{i,t-1}, \quad (4.2)$$

where z_{it} is known, and $\eta_{it} \sim N(0, \sigma_{i\eta})$, with $\sigma_{i\eta}$ known. The objective is to make inferences about β_{it} . In what follows, we will assume, as customary, that β_{it} , ε_{it} and η_{it} are stochastically independent, and α_{it} is zero⁵.

In order to present the KF in a simple way, we first outline the maximum entropy principle and the Bayesian approach to statistical inference. The former will provide an estimator for the initial prior distribution to start off the sequential procedure of the KF, and the latter will provide the recursive updating of information of the KF.

The principle of maximum entropy, first introduced by Jaynes (1957), provides a general method of inference about an unknown density, $p(\beta_{i0})$, for asset or portfolio i , when there is information about $p(\beta_{i0})$ in terms of moments. The principle states that among all

⁵ Indeed the ex-post α is almost always 0 in Mexico. We may extend the model without any problem allowing for α_t . Instead of scalars, we get vector and matrices, i.e. $\Sigma_{\varepsilon i}$ instead of $\sigma_{\varepsilon i}$, etc.

compatible distributions with the available information, we should choose as estimate, $\pi(\beta_{i0})$, for $p(\beta_{i0})$, the one with the greatest entropy

$$-\int_{-\infty}^{\infty} \log(\pi(\beta_{i0}))\pi(\beta_{i0})d\beta_{i0}.$$

Suppose that at time $t = 0$, the available information is given by $\hat{\beta}_{i0}$ and $\hat{\sigma}_{i0}$, the mean and variance-covariance matrix of β_{i0} , respectively. We may then use the principle of maximum entropy to find an estimate, $\pi(\beta_{i0})$, of the prior distribution of β_{i0} that takes into account the given information by solving the problem:

$$\text{Maximize } -\int_{-\infty}^{\infty} \log(\pi(\beta_{i0}))\pi(\beta_{i0})d\beta_{i0},$$

$$\text{subject to (initial information): } \begin{cases} \int_{-\infty}^{\infty} \pi(\beta_{i0})d\beta_{i0} = 1, \\ \int_{-\infty}^{\infty} \beta_{i0} \pi(\beta_{i0})d\beta_{i0} = \hat{\beta}_{i0}, \\ \int_{-\infty}^{\infty} (\beta_{i0} - \hat{\beta}_{i0})(\beta_{i0} - \hat{\beta}_{i0})^T \pi(\beta_{i0})d\beta_{i0} = \hat{\sigma}_{i0}. \end{cases} \quad (4.3)$$

In this case, the initial prior that maximizes entropy is given by:

$$\pi(\beta_{i0}) \propto \exp\left\{(1-\phi)F(\beta_{i0}) + \lambda_{i0} + \lambda_{i1} \beta_{i0} + \lambda_{i2} (\beta_{i0} - \hat{\beta}_{i0})^T \Lambda_{i2} (\beta_{i0} - \hat{\beta}_{i0})\right\}, \quad (4.4)$$

where λ_{i0} , λ_{i1} and λ_{i2} are the Lagrange multipliers associated with the constraints. By substituting (4.4) in the constraints, we can show that $\beta_{it} \approx N(\hat{\beta}_{i0}, \hat{\sigma}_{i0})$; see, for instance, Venegas-Martínez et al (1990).

Suppose that, at time t , we wish to make inferences about the conditional state variable $\theta_{it} = \beta_{it} | I_{it}$, where $I_{it} = \{R_{i1}, R_{i2}, \dots, R_{i,t-1}\}$. To obtain a posterior distribution of θ_{it} , the information provided by the measurement R_{it} , with density $f(R_{it} | \theta_{it})$, is used to modify the initial knowledge in $\pi(\theta_{it})$ according to Bayes' theorem:

$$f(\theta_{it} | R_{it}) \propto f(R_{it} | \theta_{it}) \pi(\theta_{it}). \quad (4.5)$$

The normalized posterior distribution is then used to make inferences about θ_{it} . We are now in a position to state the recursive updating procedure of the KF. Filter. To start off the KF procedure, we substitute (4.4) in (4.3), so the initial prior at time $t=0$, is given by $N(\hat{\beta}_{i0}, \hat{\sigma}_{i0})$, which describes the initial knowledge of the system. Proceeding inductively, at

time t , $\hat{\beta}_{i,t-1}$ and $\hat{\sigma}_{i,t-1}$ become additional information, and therefore the prior at time t is given by

$$\theta_{it} = \beta_{it} | \mathbf{I}_{it} \sim \mathbf{N}(\mathbf{z}_{it} \hat{\beta}_{i,t-1}, \mathbf{M}_{it}), \quad (4.6)$$

where

$$\mathbf{M}_{it} = \mathbf{z}_{it}^2 \hat{\sigma}_{i,t-1} + \sigma_{i,\eta-1}. \quad (4.7)$$

The sampling model (or likelihood function) is determined by

$$\mathbf{R}_{it} | \theta_{it} \sim \mathbf{N}(\mathbf{R}_{mt} \beta_{it}, \sigma_{i\varepsilon}^2). \quad (4.8)$$

The posterior distribution is then obtained by substituting both (4.6) and (4.8) in (4.5), so

$$f(\theta_{it} | \mathbf{R}_{it}) \propto \exp \left\{ -\frac{1}{2} \left[(\mathbf{R}_{mt} \beta_{it} - \mathbf{R}_{it})^2 \sigma_{i\varepsilon}^{-2} + (\beta_{it} - \mathbf{z}_{it} \hat{\beta}_{i,t-1})^2 \mathbf{M}_{it}^{-1} \right] \right\}.$$

Noting that $\pi(\theta_{it})$ is a natural conjugate prior, we may complete the squares, which is a standard technique in Bayesian inference, to get

$$\theta_{it} | \mathbf{R}_{it} \sim \mathbf{N} \left[\mathbf{z}_{it} \hat{\beta}_{i,t-1} + \mathbf{K}_{it} (\mathbf{R}_{it} - \mathbf{R}_{mt} \mathbf{z}_{it} \hat{\beta}_{i,t-1}), \mathbf{M}_{it} - \mathbf{K}_{it} \mathbf{R}_{mt} \mathbf{M}_{it} \right],$$

where

$$\mathbf{K}_{it} = \mathbf{M}_{it} \mathbf{R}_{mt}^T (\sigma_{\varepsilon it}^2 + \mathbf{R}_{mt}^2 \mathbf{M}_{it})^{-1} . \quad (4.9)$$

This, of course, means that

$$\begin{cases} \hat{\beta}_{it} = z_{it} \hat{\beta}_{i,t-1} + \mathbf{K}_{it} (\mathbf{R}_{it} - \mathbf{R}_{mt} z_{it} \hat{\beta}_{i,t-1}), \\ \hat{\sigma}_{\varepsilon it} = \mathbf{M}_{it} - \mathbf{K}_{it} \mathbf{R}_{mt} \mathbf{M}_{it}. \end{cases} \quad (4.10)$$

We then proceed with the next iteration. Equations (4.7), (4.9), and (4.10) are known in the literature as the KF. We warn the reader not to confuse the KF with the state-space representation given in (3.1) and (3.3).

Which is the relationship between KF and generalized least squares? If we suppose that $\beta_1 = \beta_2 = \dots = \beta_t$, $z_t = 1$, $\sigma_{\eta t}$ and $\sigma_{\varepsilon 0}$ vanished (i.e., when the prior is not informative), the assessment of β_i given by KF (the posterior estimate when initial information from a natural conjugate prior is available) is the same as the generalized least squares (see Venegas, 1995).

V. KALMAN FILTERING, EVENT WINDOW, ABNORMAL RETURNS AND TESTING

After defining the event of interest and identifying the period over which the stock prices of the firms involved in this event will be examined, we require a measure of the abnormal return to assess the impact of the event. The abnormal return is the actual ex post return of the stock over the event window minus the estimated normal return of the firm over the event window. Hence, the normal return is defined as the return that would be expected if the event did not take place. Thus, for firm i and event date t , we define the abnormal return of firm i at time t as:

$$AR_{it} = \varepsilon_{it} = R_{it} - E[R_{it} | \bar{R}_{mt}], \quad (5.1)$$

where

$$R_{it} = \alpha_i + R_{mt} \beta_{it} + \varepsilon_{it}, \quad (5.2)$$

and

$$\beta_{it} = z_{it} \beta_{i,t-1} + \eta_{i,t-1}. \quad (5.3)$$

Finally, estimators of the time varying parameters satisfy

$$\hat{\beta}_{it} = z_{it} \hat{\beta}_{i,t-1} + K_t (R_{it} - R_{mt} z_{it} \hat{\beta}_{i,t-1}). \quad (5.4)$$

Then we proceed as usual, estimating average abnormal returns (AAR_t) across firms in time t , cumulate average abnormal returns in the window event (CAR_t), and using a t-statistic to test the null hypothesis of zero abnormal returns in AAR_t and CAR_t (see Dubcovsky and García, 1996).

In order to eliminate the dependence on past security returns in estimating the variance of the aggregated abnormal returns, we use the cross section to form an estimator of the variance for the t-test:

$$\hat{V}AR_t \left[AAR_t(\hat{\beta}_{it}) \right] = \frac{1}{N} \sum_{i=1}^{N_t} \left[AR_{it}(\hat{\beta}_{it}) - AAR_t(\hat{\beta}_{it}) \right]^2. \quad (5.5)$$

In the case of CAR_t , adjusting for first-order autocorrelation in the abnormal returns

$$\hat{V}AR_{CAR(U)}(\tau_1, \tau_2, \hat{\beta}_{it}) = U \hat{V}AR_t(\tau_1, \tau_2, \hat{\beta}_{it}) \left[1 + \frac{U}{T} + \frac{U(\sum R_{mt}/U - \overline{R_m})^2}{\sum (R_{mt} - \overline{R_m})^2} \right], \quad (5.6)$$

where, U = Accumulation period from τ_1 to τ_2 , and T = Estimation period of length T ,

$\overline{R_m}$ = Average market return during estimation period and

$$\widehat{\text{VAR}}_t(\tau_1, \tau_2, \hat{\beta}_{it}) = \frac{1}{U} \sum_{t=\tau_1}^{\tau_2} \left[\text{AAR}_t(\hat{\beta}_{it}) - \overline{\text{AAR}}_U(\hat{\beta}_{it}) \right]^2 \quad (5.7)$$

For these estimators of the variance to be consistent we require the abnormal returns to be uncorrelated in the cross section. It is important to point out that an absence of clustering is required. Notice also that cross-sectional homoskedasticity is not required for consistency. Given these variance estimators, the null hypothesis H_0 : that the average and/or the cumulative abnormal returns are zero can then be tested using large sample theory given the consistent estimators of the variances in (5.5) and (5.6).

VI. SUMMARY AND CONCLUSIONS

Even though the event-study methodology has a wide applicability to a variety of firms and events, it has been missing an extension considering time varying parameters. In this research, we have extended the event-study methodology, into a richer dynamic environment, by including parameters that change with time. We use the Kalman filter to model parameters depending on time in a state-space representation of the statistical market model of the event-study analysis. We also apply Bayesian inference to updating relevant information and use information theory to choose the initial distribution of the parameters. The proposed extension leads to a more robust set-up in appraising the impact of economic and financial events on the market value of firms.

Needless to say, it remains to do some empirical work on using our methodology. To this end, we will devote ourselves to elaborate some empirical analysis for the Mexican case in several coming papers.

Our theoretical framework is encouraging and suggests further research in several directions. For instance, we may extend the use of KF to generate the residuals in the event window and use them to test for abnormal returns. Finally it is crucial to investigate how the effects display long-run tendencies that affect the market value of the firm.

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