Sectoral Economic Growth and Employment in Mexico, 1996-2001

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■ **Abstract:** This paper shows the results from a study of the impact of sectoral economic growth on unemployment in Mexico for the period 1996-2001, realized by applying a disaggregate approach on data from the National Employment Survey (*Encuesta Nacional de Empleo*). The paper, which draws from some previous work related to Okun´s Law, includes a discussion of the theoretical aspects of the sectoral contributions to growth, as well as of the relationship between production and employment and the working of labor markets, and it also describes the recent evolution of unemployment in Mexico. The core of the paper rests upon the analysis of panel data to estimate the open unemployment rate; it also includes the study of regional urban/rural growth and unemployment in different sectors for ten different Mexican regions. The results from the analysis at the regional level show that unemployment in Mexico has a statistically significant negative effect on sectoral economic growth. Also, evidence was found suggesting that promoting sectoral-regional (urban/rural) growth could be an effective way to reduce unemployment.

■ **Resumen:** Este trabajo muestra los resultados de un estudio del impacto del crecimiento económico sectorial en el desempleo en México para el periodo 1996-2001. Éste fue realizado con datos desagregados de la Encuesta Nacional de Empleo. El ensayo, que se deriva de trabajos previos relacionados con la ley de Okun, inclu-

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ye una discusión de aspectos teóricos sobre la contribución de los distintos sectores económicos al crecimiento, así como la relación entre la producción y el empleo en México. La parte central del ensayo se basa en el análisis de datos en forma de panel para estimar la tasa abierta de desempleo; además, incluye el estudio del crecimiento y desempleo regional urbano/rural en distintos sectores de diez diferentes regiones en México. Los resultados del análisis al nivel regional muestran que el desempleo en México tiene un efecto negativo y estadísticamente significativo en el crecimiento económico. Además, se encontró evidencia que sugiere que la promoción del crecimiento sectorial-regional (urbano/rural) puede ser una forma efectiva para reducir el desempleo.

- ■ **Key words:** Sectoral growth, unemployment, Okun's Law, panel data.

- ■ **JEL Code:** E24, O41.

- ■ *Introduction*

Empirical evidence shows a direct relationship between employment and production. Most of the studies on this subject follow the methodological approach known as Okun's Law, which looks upon the change in the rate of employment resulting from a deviation of the rate of growth of production with respect to a rate considered as normal.[4]

However, models which estimate Okun's Law offer good results only when applied to the United States of America.[5] This is mainly because when considering other countries, the estimated coefficients for production are relatively small, and therefore do not give a strong coefficient for Okun's Law. Chavarín (2001) used some theoretical and econometric extensions of Okun's model (Okun, 1962) to study the Mexican case, and found a coefficient for Okun's Law equal to -0.024, thereby implying that a one percent increase in the unemployment rate will represent a 2.4 percent decrease on Gross Domestic Product (GDP).

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4. The normal rate results from the addition of the rate of growth of labor productivity and the growth rate of the labor supply. That is the rate at which production must grow so that the unemployment rate remains unchanged.
5. A model usually used for the estimation of Okun's Law is as follows: $Unemployment_t = \beta_0 + \beta_1 \, Product_t + \varepsilon_t$.

The studies on the subject are usually applied to the general situation of a country at an aggregate level; however, there still remains the preoccupation about the structural composition of production growth and unemployment. For policy matters, it is important to disaggregate those effects into sectoral (rural *versus* urban), regional or state levels so that one can have a better understanding of the production-unemployment relationship. This paper follows a disaggregated approach, and it is based on the information from six employment national surveys realized by the Mexican government annually during the period 1996-2001. [6]

Through the analysis of a model with regional panel data, the paper estimates the rate of open unemployment for the existing ten Mexican regions and for each of the six years period mentioned before. Thus, the model allows both the analysis of the impact of economic growth on general unemployment as well as the impact that such growth has on unemployment within different sectors of economic activity.

The paper is divided into five sections. Section 2 describes the theoretical framework for the analysis of the relationship between economic growth and unemployment. Section 3 describes the methodology and the data used to estimate regional unemployment rates. Section 4 includes the testing of the model on the basis of Mexican regional panel data for the period 1996-2001. Section 5 includes the conclusions from the study.

■ *Theoretical framework*

The relationship between production and unemployment

The World Bank argues that economic growth reduces poverty and inequality in industrialized and developing countries (World Bank, 1995). Also, the International Labor Organization (ILO) maintains that in general, a dynamic economy (that whose growth responds to an expanding demand for goods and services) must provide sufficient productive employment opportunities. Such opportunities should help in satisfying the needs of all the unemployed and underemployed workers and also of those just entering the labor market. Thus, it is important for economic growth to be strong, but it is also needed for it to be constant.[7]

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6. *Encuesta Nacional de Empleo* (National Employment Survey) realized by Instituto Nacional de Estadística, Geografía e Informática (INEGI).

7. Another preoccupation is the structural (rural-urban) behavior of employment. The

González Anaya (1999) did one of the pioneering studies of the Latin American labor market. Such a study analyzes the flexibility of the labor market in thirteen Latin American countries for the period 1960-1995, and it compares such flexibility with that of the United States of America. Specifically, it estimates the sensibility of unemployment, employment, and the wage rate with respect to production, both in the short-run and in the long-run.

The author argues that in the long-run, countries with stable price levels had increases in their wage income shares as the workers had better salaries because of their increased productivity levels. The argument suggests an alternative way to estimate the response of unemployment to changes in production through Okun's law. Such law establishes that a drop by one percent in unemployment is associated with a three percent increase in production.[8] This ratio of three to one is known as Okun's law.[9] But it is also known as Okun's coefficient (González Anaya, 1999).

In fact, as it was said before, it was found that for the United States, a one percent drop in the unemployment rate is associated with a three percent increase in production, thus invalidating the basic postulates of the diminishing marginal profits from labor, and also the ones of constant returns to scale.[10] Okun's employment and unemployment coefficients vary between 1.0 to 3.0 percentage points for Latin America, whereas for the United States they vary between 3.0 to 4.0 percentage points (González Anaya, 1999).

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impossibility for the non-agricultural sectors to absorb large increments of the labor force and the strong migration of workers from the countryside to the cities have led many to suggest that in the present stage of development, one has to look more closely at the expansion of rural employment as the only way to provide employment for all.

8. See: Dornbusch and Fisher (1984).
9. The literature on the subject has been divided following the original Okun's convention about the wording of the coefficient, as the percentage change in production as a result of percentage changes in unemployment (which is 3.0), *versus* its reciprocal, which indicates the percentage changes in unemployment associated with a percentage change in production (which is 0.33). Because we almost always have labor market variables as dependent variables when running the regressions, we used the second option; that is, the reciprocal. Thus, a large coefficient indicates a great sensibility of the labor market to production.
10. Nonetheless, Nourzad and Almaghrbi (1995) mention that the most well known studies of Okun's law for the United States show an average value of 2.57. González Anaya (1999) shows that fluctuations in production of the Latin American economies have a lesser effect on the quantitative variables (unemployment and employment) but a stronger effect on real wages. Specifically, he finds that Okun's coefficients for wages in Latin America are larger than 1.0, whereas in the United Sates, it is 0.5.

For the Mexican case, González Anaya (1999) finds that Okun's unemployment coefficient (1.7%) is small as compared to the one for the United States. In that study, it is shown that Mexico was one of the few countries which did not have an increase in the Okun-unemployment relationship for the period 1971-1995. Such a behavior was found because there was a drop in the relationship Okun-wage rate, causing an inflexibility of the labor markets, due to the reduced number of channels available for the transmission of the perturbances of production on employment. And since in Mexico there were not changes in the wage rate channel during the period of macroeconomic stabilization (1982-1994), it is not surprising to find small increments in both the Okun-employment and the Okun-unemployment relationships only after the economic crisis of 1995.

Through traditional estimations of the effects of production on unemployment for some countries such as Mexico, Okun's law does not offer adequate explanations about the reverse relationship; that is, the effects of unemployment on production.[11] Barreto and Howland (1993) show that under certain conditions there are two main advantages when applying the inverse regression (one where production is the dependent variable) in the traditional models. These are the following: a) it allows for better calculations, from the statistical point of view of the influence

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11. Okun postulated some mechanisms for the transmission of the effects of production on the unemployment rate, including the following: 1. *A pro-cyclical behavior of the labor force.* This happens when there is an increase in the labor force during a period of growth of the product. Nevertheless, during the economic cycle there are two opposing forces working on the size of the labor force: *The substitution effect which generates a pro-cyclical labor force.* During a period of growth of production, wages increase causing an increase in the opportunity cost of leisure. This is shown through an increase in the number of participants (particularly women and youths) in the labor force. On the contrary, when the product falls one can observe discouraged workers (because of the discourage effect). *The income effect, that causes a counter-cyclical behavior of the labor force.* This happens when the head of the family is unemployed and therefore other members are induced to enter the labor force. 2. *Labor accumulation.* This implies that the average number of hours worked by each worker has a pro-cyclical behavior, enhancing therefore the unemployment fluctuations. In the cases of product expansions, the firms prefer to increase the number of hours per worker and the number of shifts, rather than to increase the number of workers, and *viceversa* when production shrinks. 3. *Labor productivity moves pro-cyclically.* There are some mechanisms through which productivity has a pro-cyclical behavior: a) employment shows a lag in responding to product changes; b) the increase in the labor force; iii) changes in the composition of the industrial production toward more productive activities during periods of production expansion. Okun's coefficient assumes that those three effects change *pari passu* with the unemployment rate, and that their combined effects are captured by the coefficient.

of unemployment on production; b) it allows the calculation of more plausible values for Okun's law (Chavarín, 2001).

Following Barreto and Howland (1993) and Chavarín (2001), we estimated the relationships for Mexico using the inverse regression from two approaches. First, we took Gross Domestic Product and unemployment as stationary variables at level, considering an adjustment relationship, through time, between them. Second, we considered that production can be a non-stationary variable at level, whereas unemployment is indeed stationary. This implies taking as a starting point a disequilibrated equation, which is solved through a dynamic model (to equilibrate it), together with some specifications with theoretical and econometric extensions (Chavarín, 2001).

We obtained different results from the estimation of Okun's law with a dynamic model, even though the value of the coefficient still was different from the one estimated for the United States. With such results, one can conclude that estimations based on regressions ran in the traditional way overestimate the value of the Law. Thus, it is necessary to explore the estimations with the help of an inverse regression. In fact, if one wants to calculate the opportunity cost of unemployment, measured in terms of Gross Domestic Product, one has to use the inverse regression. In other words, the dependent variable must be production, whereas unemployment becomes an explanatory variable.[12]

Such results show the image of the general situation of the country as a whole (at an aggregate level), but they do not show the structure of the results. Therefore, it is important to disaggregate those effects into various sectors and levels (rural/urban, regional and state), in order to have a better insight of the composition of the production-unemployment relationship.

The structure of economic growth and unemployment

Ravallion and Datt (1996) showed that sectoral economic growth in India has an important general effect in reducing poverty, and that such an effect is stronger in the case of agricultural growth.[13]

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12. Chavarín (2001) realized such estimation for Mexico for the period 1987-2000, and found that the short-run multiplier which is the coefficient of the explanatory variable (unemployment) was equal to minus 0.024. Thus, the value of the coefficient (2.4) is very similar to the one estimated for the United States, and therefore, a one percent increase in the unemployment rate has a 2.4 percent reduction of GDP.

13. In their study, Ravallion and Datt tried to measure the importance of intra-sectoral growth for the Indian poor, and also tried to identify the impact of rural-urban migration in all sectors. Their main findings include the following: a) urban growth carried

Torres (2002) conducted a study similar to Ravallion and Datta's for Mexico, and estimated the impact of sectoral growth on regional poverty, as well as the effects of migration on the urban/rural sectors. In that study, Torres found a significant effect of economic growth on reducing poverty in Mexico for the period 1984-2000. On the basis of a model with panel data, the author estimated regional poverty and *per capita* expenditures, finding an elasticity of total poverty with respect to urban growth of around -1.143, while for rural growth the corresponding value was -0.551. He also found evidence of *intra-sectoral* effects of growth.[14]

■ *Methodology and data*

Estimation of the Unemployment Rate for Mexico

Since the mid 80's, Mexico has been subjected to a vigorous process of stabilization and structural adjustment; the old inflationary periods and the government budget deficits were controlled, and the Mexican government carried out some of the structural reforms suggested by the international organizations. As a result of that, there was a significant inflow of foreign investment and the economy seemed recovered from the 1986 recession, with the help of a strong response of the export sector to the liberalization of foreign trade (Lustig, 1998).

However, by the end of the year 1994, the Mexican economy experienced a severe financial crisis which in turn caused an economic crisis worse than the ones suffered by the country in 1982 and in 1986. Real GDP dropped 6.9 percent in 1995, whereas aggregate consumption decreased by 11.7 percent in that year. In fact, real income *per capita* went back up to the 1994 level only until the second quarter of 1997. Afterwards, the economy recuperated and GDP grew around seven percent

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along some benefits for the urban poor in India but had no impact on rural poverty. Besides, changes in the urban-rural structure of population had no significant impact on poverty. However, the growth of the industrial sector did not reduce poverty in any sector; b) the direct impact of growth (in any sector) on general poverty is limited by the participation of population in the respective sector. By decomposing national income growth by sectors defined by the type of product, the study found significant differences on their impact on poverty. Growth in the primary and tertiary sectors helped to reduce rural and urban poverty. As it was said above, industrial growth, on the contrary, did not have any impact at all on reducing poverty in India.

14. That is, rural and urban growths significantly reduce poverty within their own sector. But there are also inter-sectoral effects, as the data show that urban growth significantly reduces poverty in the rural sector. On the estimation of the effects of rural-urban migration, Torres' results were non-significant.

in the year 2000, but growth could not be sustained as GDP fell by 0.24 percent in 2001. Thus a question comes in order: what have been the impacts of those periods of expansion and recession on unemployment in Mexico?

We will try to answer that question with the help of data from the National Employment Surveys for the period 1996-2001, to estimate what is called the 'rate of open unemployment' (ROU), at the national, regional and state levels (OIT, 1971).[15]

At present, the rate of open unemployment in Mexico is calculated as follows:

(1)   ROU = (OU/EAP)* 100
          where: OU = openly unemployed
          EAP = economically active population

The National Employment Survey (NES)

The National Employment Survey is probabilistic and since 1995, it is carried out annually in Mexico.[16] Originally, the NES offered information for the nation and state levels, with localities grouped into two categories, according to total population: greater than 100,000 and smaller than 100,000 inhabitants.[17] The Survey is stratified with the household being the selection unit and the individual, the observation unit. In the case of this study, the Survey is disaggregated also at a regional level, following the regional division proposed by INEGI, which is the institution that conducts the Survey.[18] For the validity of our estimations, the standard errors were calculated along with the unemployment rates, as it is shown in the next paragraphs.

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15. The Rate of Open Unemployment is a proportion of the Economically Active Population (EAP) or labor force. The EAP refers to all people in working age who either had a job or did not have one but were looking for one at the time of the estimation. Those who had a job are known as 'occupied', while the second group is known as 'openly unemployed'. The proportion of the population in the working age who were neither 'occupied' nor looking for a job at the time of the estimation, are classified as Economically Inactive Population.

16. Although the NES was carried out every two years in Mexico before 1995, we used the 1996-2001 annual series for practical purposes.

17. By the year 2000, the Survey allowed information for four groups of localities: greater than 100,000 inhabitants; between 15,000 and 99,999; between 2,500 and 14,999, and; less than 2,500 inhabitants.

18. The way the states were aggregated into regions for this study can be found in the Appendix, Table A1.

Estimation of the unemployment rates and the standard errors

Because of the need for the national surveys to be representative, one has to distinguish between the differences at the population level and the variations at the sample level. Some authors have stressed this need and have proposed some tools to calculate the relevant standard errors (Kakwani, 1993; Ravallion, 1994). Also, some survey samples (such as the NES's) are not calculated randomly among the households of the country, but instead they respond to some stratification. Thus, the need for the calculation of the standard errors.[19]

Table 1, includes the variability coefficients for the estimations at the state and regional levels.[20] From the data included in Table 1, one can see that for the total unemployment rate, the coefficient of variability (ee/μ) has a mean value of 0.0024 for the regional case, whereas it has a mean value of 0.0033 at the state level.

TABLE 1
Standard Errors for the Estimation of Unemployment
Rates (%): 1996-2001

	Coefficients of variability ee/μ	
Statistics	*State level*	*Regional level*
Total unemployment		
Mean	0.33	0.24
Standard Deviation	0.23	0.14
Rank	2.16	0.64
Maximum	2.21	0.73
Minimum	0.04	0.09
Urban unemployment		
Mean	0.38	0.33
Standard Deviation	0.20	0.28
Rank	1.24	1.19
Maximum	1.33	1.22

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19. In order to calculate the unemployment rates at different levels of aggregation, we used the Svyratio command of the econometric package Stata, which allows the incorporation of the complex sample design into the calculation of the standard errors for the unemployment rates (at those different levels of aggregation) following the methodology proposed by Howes and Lanjouw (1998).

20. The estimations of the unemployment rates at the national and regional levels for both the rural and the urban areas are shown below. The regional estimates are included in Table A2 in the Appendix.

	Coefficients of variability ee/μ	
Statistics	State level	Regional level
Minimum	0.09	0.03
Rural unemployment		
Mean	0.47	0.29
Standard Deviation	0.49	0.15
Rank	3.72	3.72
Maximum	3.72	0.73
Minimum	0.00	0.10

Source: Calculated from the NES, 1996-2001.

The estimated unemployment rates for the nation as a whole are shown in Table 2, and also in Figure 1. As it can be seen from the data shown in that table and that figure, there was a relative fall in unemployment in Mexico during the period under consideration (1996-2001).

Total national unemployment fell around an accumulated 56.3 percent during 1996-2000, and it increased by about 4.5 percent by the end of 2001, in both urban and rural areas. Rural unemployment diminished by 47.1 percent during the 1996-2000 period, but increased by 20.5 percent in 2001. Table 2 also shows the standard errors for the unemployment estimations, which are rather small, suggesting that the estimated unemployment measures are correct.

TABLE 2
Estimated Unemployment Rates (%) at the National Level:
Mexico, 1996-2001[a]

Open unemployment rates	Years					
	1996	1997	1998	1999	2000	2001
Total	3.75	2.57	2.25	1.73	1.63	171
	(0.11)	(0.17)	(0.10)	(0.10)	(0.05)	(0.06)
Urban	4.63	3.14	2.72	2.19	1.94	1.99
	(0.14)	(0.19)	(0.11)	(0.12)	(0.06)	(0.07)
Rural	1.17	1.11	0.87	0.40	0.62	0.75
	(0.14)	(0.30)	(0.12)	(0.06)	(0.08)	(0.11)

[a] Standard errors are shown inside parentheses.
Source: Calculated from NES, 1996-2001.

At the regional level, the Central-Southern and Central regions showed the highest unemployment rates for the period, while the Southern and

Southeastern regions had the lowest ones, on the average (see Table 3). As it can be seen from the data shown in Table 3, rural unemployment was lower than the urban one in all (ten) Mexican regions in 1996-2001. Also, the data shows, on the average, a generalized tendency to lower unemployment rates across the country for that period.

TABLE 3
Open Regional Unemployment Rates (%) for México, 1996-2001[a]

Regions	Unemployment rates		
	Total	Rural	Urban
All ten regions	2.16	1.13	2.55
Northeast	2.63	1.44	2.79
Northwest	2.82	1.14	3.28
Central-South	2.89	1.01	3.38
South	1.19	0.45	2.02
Southeast	1.40	0.58	1.60
West	1.69	0.43	2.09
Central-North	1.80	0.78	2.28
East	2.01	0.90	2.69
North	1.86	0.77	2.31
Central	4.15	3.51	4.15

[a] Average unemployment rates.

Source: Calculated from NES, 1996-2001.

Table 4 shows the national labor force at the national and regional levels for rural and urban areas. As it can be seen from the data shown in that table, the Economically Active Population increased 9.5 percent for the period; the urban labor force increased 25.7 percent, while in the rural areas, the labor force increased by only 1.9 percent during the period.

FIGURE 1

Total, Urban and Rural Unemployment Rates for Mexico, 1996-2001
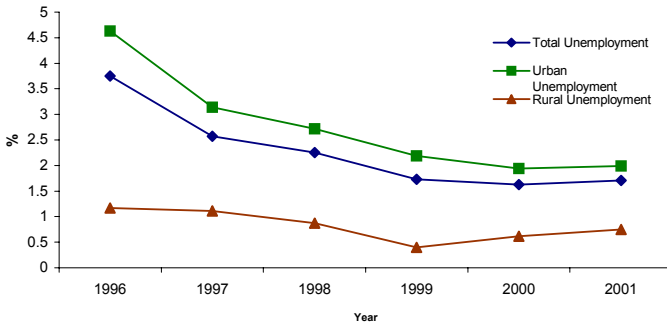
Source: Calculated from NES, 1996-2001.

It is interesting to notice that most of the labor force in the country is urban and it is located in the Central-Southern and Eastern regions, and also that while the unemployment rates were falling, the labor force was increasing, both at the national and regional levels (Figure 2). This suggests that the economy was creating job opportunities both for those who had entered the labor force for the first time and also for those who were already there, but were looking for a job at the time of the estimations (see Figure 3).

FIGURE 2

National Unemployment and Labor Supply for Mexico, 1996-2001
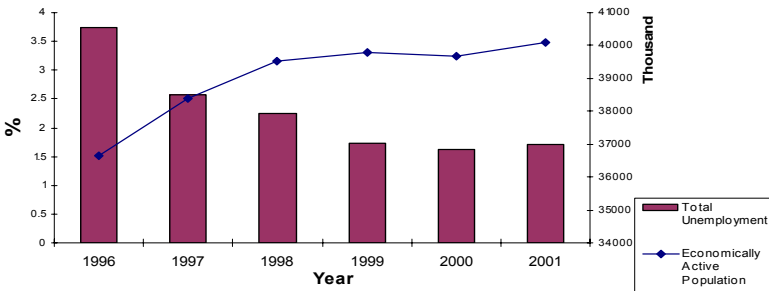
Source: Calculated from NES, 1996-2001.

TABLE 4

National, Urban, Rural and Regional Labor Force: Mexico, 1996-2001

Levels	Years					
	1996	1997	1998	1999	2000	2001
National	36635051	38370994	39541580	39786759	39663487	40097299
Urban	27306662	27506376	29453678	29686552	30438938	34338617
Rural	9328389	10864618	10087902	10100207	9224549	9505796
Regional						
Northeast	3555870	3686309	3719687	3605348	3747114	3725154
Northwest	2894595	2931077	3195876	3117459	3167197	3369142
Central-South	6540972	6808930	7184979	7223701	7235477	7205884
South	3273037	3622574	3632550	3657519	3683301	3766721
Southeast	1148550	1078769	1285339	1327780	1329071	1425047
West	4630690	5349006	4972463	4931591	4943563	5165071
Central-North	3152015	3006195	3361421	3417383	3508020	3538162
East	5493740	5707191	6072732	6064542	5934407	5811415
North	2163740	2209181	2264209	2398514	2285967	2271307
Central	3781842	3971762	3852324	4042922	3829370	3819396

Source: Calculated from NES, 1996-2001.

FIGURE 3

Unemployment and Gross Domestic Product for Mexico, 1996-2001
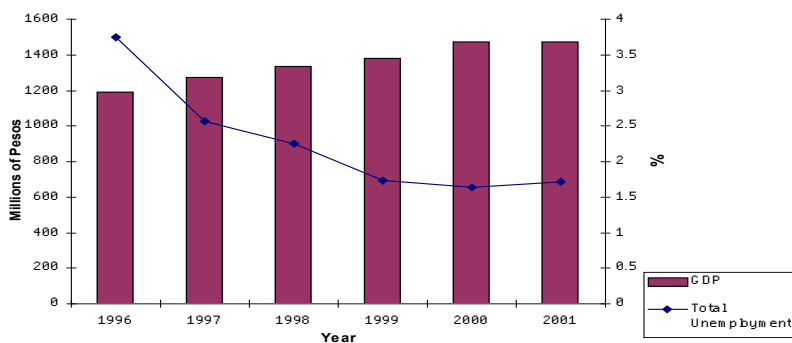
Source: Calculated from NES, 1996-2001.

Figure 3 shows that, as expected, during the period 1996-2000, while GDP was growing, unemployment was falling. However, in 2001, the reverse effect took place: GDP fell, while unemployment grew.[21]

The econometric strategy
The strategy followed in this study is to analyze the covariate impacts of growth of both unemployment and GDP. Previous studies have found a significant negative relationship between total unemployment and economic growth. In this section, the relationship between the variations in unemployment and GDP is studied, gaining some degrees of freedom with respect to the national aggregate case.

Having a certain initial unemployment rate and a certain level of production, the relationship between both of them is determined by how changes in unemployment and production take place and also by how they covariate through time. It is expected to have different results for different regions, as the initial conditions and the working of the regional labor markets could differ from region to region. So long as such regional differences in the time patterns of unemployment are due to differences in the time patterns of growth for different economic activities, it would be appropriate to use the model (panel) proposed for this study. The panel model attempts at estimating the elasticities of unemployment with respect to economic (GDP) growth.

■ *Estimating unemployment and sectoral growth in rural and urban areas*

In this section we try to develop a complete structural model to find some causality between the variables included in the model. Following Ravallion and Datt (1996), we attempt at knowing the importance of the sectoral composition of growth of unemployment, by specifically controlling population movements and cross effects among regions and/or areas.[22]

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21. Nonetheless, as it can be seen from Figure A1 (Appendix), at the regional level, upon occasion during the period 1996-2000, both gdp and unemployment fell down simultaneously in some regions, thereby suggesting that at the regional level, unemployment changed mainly because of the working of the labor market and not neccesarily because of corresponding changes in production.

22. Ravallion and Datt (1996) used time-series analysis to study the India case because they had access to more than 30 annual surveys conducted in that country. Because of lack of information, we decided to use the panel techniques for the Mexican case.

Thus, the average unemployment level for region i in year t, can be decomposed as follows:

$$(2) \quad \mu = \eta^u_{it}\mu^u_{it} + \eta^r_{it}\mu^r_{it}$$

Where η^k and μ^k show the proportion of population and the measure of unemployment, respectively for areas $k = u, r$, (urban and rural). Similarly, GDP can be written as follows:

$$(3) \quad \pi_{it} = \eta^u_{it}\pi^u_{it} + \eta^r_{it}\pi^r_{it}$$

Where π^k is the average product for sector k.

Since $s^\mu_{k,it} = \eta_k\mu_k/\mu$, and $s^\pi_k = \eta_k\pi_k/\pi$, are the proportions of total unemployment and GDP of the k sector for region i in year t, respectively, the rate of growth of unemployment can be decomposed by obtaining the total differentiation of equation (2) as follows:

$$(4) \quad d\ln\mu_{it} = s^\mu_{uit}d\ln\mu_{uit} + s^\mu_{rit}d\ln\mu_{rit} + (s^\mu_{uit} - s^\mu_{rit}\eta_{uit}/\eta_{rit})d\ln\eta_{uit}$$

Equation (4) shows the average rate of change in unemployment which depends upon the change in the number of unemployed people within each sector. This is due to the weighted proportion of the rate of change in unemployment within each sector ($s^\mu_k d\ln\mu_k$), plus the independent contribution of urbanization. The coefficient for $d\ln\eta_u$ can be written also as $(\mu_u - \mu_r)\eta_u/\mu$, which indicates that urbanization will reduce unemployment when unemployment is larger in rural than in urban areas.
One could also differentiate equation (3) as follows:

$$(5) \quad d\ln\pi_{it} = s^\pi_{uit}d\ln\pi_{uit} + s^\pi_{rit}d\ln\pi_{rit} + (s^\pi_{uit} - s^\pi_{rit}\eta_{uit}/\eta_{rit})d\ln\eta_{uit}$$

Thus decomposing the average rate of growth of GDP as well.
Ravallion and Datt's equation for poverty can be applied for unemployment by using the following regression equation:

$$(6) \quad \Delta\ln\mu_t =$$

$$\beta_u s^\pi_{uit-1}\Delta\ln\pi_{uit} + \beta_r s^\pi_{rit-1}\Delta\ln\pi_{rit} + \beta_\eta(s^\pi_{rit-1} - s^\pi_{uit-1}\eta_{rit-1}/\eta_{uit-1})\Delta\ln r_{it} + \varepsilon_{it}$$

For all t = 2,…T, where the β's are parameters to be estimated; Δ is the difference operator for discrete time. Coefficients β_u y β_r can be interpreted as the impact (weighted participation) of GDP growth in urban and rural areas, respectively, while β_η shows the population movements from rural to urban areas.

It is clear that there must exist some other independent factors which influence the measurement of unemployment (including the errors in the measures), thus the inclusion of the probabilistic error term, ε.

Under the null hypothesis: $\beta_u = \beta_r = \beta_\eta = \beta$, equation (6) collapses into:

$$(7) \qquad \Delta \ln \mu_{it} = \beta \Delta \ln \pi_{it} + \varepsilon_{it}$$

Thus, under the null hypothesis, $\beta_u = \beta_r = \beta_\eta$ the total economic growth rate is the most important one. However, as it was said before, the objective of this paper is to know whether or not the economic growth in one sector or area influences the distribution of unemployment in other sectors. Thus, in order to be able to achieve that objective, one could use equation (4) to decompose the average rate of economic growth as follows (without the time subscript for short):

$$(8) \quad s^\mu{}_u \Delta \ln \mu_u = \beta_{u1} s^\pi{}_u \Delta \ln \pi_u + \beta_{u2} s^\pi{}_r \Delta \ln \pi_r + \beta_{u3}(s^\pi{}_r - s^\pi{}_u \eta_r / \eta_u) \Delta \ln \eta_r + \varepsilon_u$$

$$(9) \quad s^\mu{}_r \Delta \ln \mu_r = \beta_{r1} s^\pi{}_u \Delta \ln \pi_u + \beta_{r2} s^\pi{}_r \Delta \ln \pi_r + \beta_{r3}(s^\pi{}_r - s^\pi{}_u \eta_r / \eta_u) \Delta \ln \eta_r + \varepsilon_r$$

$$(10) \quad \begin{aligned} &(s^\mu{}_r - s^\mu{}_u \eta_r / \eta_u) \Delta \ln \eta_r = \\ &\beta_{\eta 1} s^\pi{}_u \Delta \ln \pi_u + \beta_{\eta 2} s^\pi{}_r \Delta \ln \pi_r + \beta_{\eta 3}(s^\pi{}_r - s^\pi{}_u \eta_r / \eta_u) \Delta \ln \eta_r + \varepsilon_\eta \end{aligned}$$

Where the overall β_i is $\beta_i = \beta_{ui} + \beta_{ri} + \beta_{\eta i}$; $i = 1, 2, 3$. Equation (6) is obtained by adding equations (8), (9) and (10). Equation (8) shows how the composition of economic growth and population changes affect urban unemployment, and equation (9) shows their corresponding effect in rural areas. Equation (10) shows the effect related to population changes, $\Delta ln\mu$. Equations (8) and (9) are estimated. Equation (10) does not have to be estimated because its parameters can be inferred from the estimates of equations (6), (8), and (9), by using the additive restriction $\beta_{\eta i} = \beta_i - \beta_{ri} - \beta_{ui}$; $i = 1, 2, 3$.

Equations (6), (8),(9), and (10) can not be estimated correctly for Mexico as there is lack of information about GDP by area (urban, rural). Thus, the analysis of the effects of the composition of growth on

employment can be done only by economic activity. This is better and much easier than the urban-rural approach. Easier, because population changes are negligible among activities; better, because the analysis can be more precise in terms of estimating the effects of the economic composition of production growth.

Starting with the *per capita* GDP for the primary, secondary and tertiary sector components, $Y_{it} = Y_{1it} + Y_{2it} + Y_{3it}$, and noticing that the rate of growth of Y_{it} can be approximated by the sum of the weighted sectors' rates of growth for region i in year t, then the equation for the effect of the composition of product growth on unemployment can be written as follows:

$$(11) \quad \Delta \ln \mu_{it} = \beta_1 s_{1it} \Delta \ln Y_{1it} + \beta_2 s_{2it} \Delta \ln Y_{2it} + \beta_3 s_{3it} \Delta \ln Y_{3it} + \varepsilon_{Yit}$$

Where $s_{1it} = Y_{1it}/Y_{it}$.

Equation (11) can be rewritten for its components as follows:

$$(12) \quad s^{\mu}_{uit-1} \Delta \ln \mu_{uit} = $$
$$\beta^*_{u_1} s_{1it} \Delta \ln Y_{1it} + \beta^*_{u_2} s_{2it} \Delta \ln Y_{2it} + \beta^*_{u_3} s_{3it} \Delta \ln Y_{3it} + \varepsilon^*_{uit}$$

$$(13) \quad s^{\mu}_{rit-1} \Delta \ln \mu_{rit} = $$
$$\beta^*_{u_1} s_{1it} \Delta \ln Y_{1it} + \beta^*_{u_2} s_{2it} \Delta \ln Y_{2it} + \beta^*_{u_3} s_{3it} \Delta \ln Y_{3it} + \varepsilon^*_{rit}$$

$$(14) \quad s^{\mu}_{rit-1} - s^{\mu}_{uit-1} \eta_{rit-1} / \eta_{uit-1}) \Delta \ln \eta_{rit} = $$
$$\beta^*_{\eta_1} s_{1it} \Delta \ln Y_{1it} + \beta^*_{\eta_2} s_{2it} \Delta \ln Y_{2it} + \beta^*_{\eta_3} s_{3it} \Delta \ln Y_{3it} + \varepsilon^*_{\eta it}$$

This separated scheme allows the testing of the differential effects of economic growth of different sectors both on urban and rural unemployment and on rural-urban migration. As before, equations (12) through (14), are estimated under the condition that $\beta^*_{\eta i} = \beta^*_i - \beta^*_{ri} - \beta^*_{ui}$; $i = 1, 2, 3$, in order to infer the parameters for equation (11).

In regressions for total unemployment (equations (6) and (11)), elasticities are estimated by multiplying the regression coefficients by the relevant product proportions (share of GDP for each sector). For the decomposition of the rates of change on average unemployment (as in equations (11) and (12)), the elasticity of unemployment in sector k (u, r) for growth in sector j, can be estimated by multiplying the coeffi-

cient from the regression for *j*, by the GDP share of that sector, relative to the share of sector *k* on total unemployment.[23]

■ *Empirical evidence of the effect of growth on regional unemployment in Mexico, 1996-2001*

The results from the estimations of regressions ran with the panel data through fixed effects for the ten mexican regions are shown in Table 5.[24] Table 6 includes the estimated mid-point elasticities, whereas Table 7 shows the elasticities for unemployment, estimated by region. Such results suggests that the composition of economic growth by activity plays a very important role in reducing unemployment in Mexico, notwithstanding that only the growth of the secondary sector affects unemployment in a significant manner.[25] The results also suggest that rural unemployment is most affected by growth in the primary sector, and that only the secondary sector growth reduces urban unemployment.

Table 5 shows an estimated value for elasticity (using ordinary MLS) for total unemployment with respect to growth in the secondary sector of -2.06.[26] This means that an increase of one percent in production of the secondary sector is associated with a fall of two percent in the total unemployment rate. In urban areas, the elasticity of unemployment with respect to growth in the secondary sector was -2.04. For the rural areas, the elasticity of unemployment with respect to growth in the primary sector was -7.32.

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23. The economic sectors considered for the decomposition of growth are: a) primary, which includes agriculture, livestock, forestry, fisheries and mining; b) secondary, including manufacturing, construction, electricity, gas and water supplies; c) tertiary, which includes commerce, hotels, restaurants, transportation, communications, financing, insurance, realty, commercial services, and personal services.
24. We also estimated rates of unemployment at the state level (see Table A3 in the Appendix). The so estimated coefficients are smaller (in absolute terms) than the ones estimated at the regional level with the panel data. Moreover, some of the coefficients at the state level have signs contrary to the ones estimated at the regional level.
25. We also estimated the Alternative Rate of Open Unemployment, both total and by sector (urban-rural), thereby estimating equations (12), (13), and (14). Those results show that none of the sectors' growth causes the reduction of unemployment in the three sectors considered. We arrived at similar results when estimating the Partial Unemployment Rates for Market and Occupation Proportions.
26. A Wald test with Ho: elasticity = -1 for urban growth could not be rejected, while a similar test for rural unemployment had to be rejected.

TABLE 5

Impact of the Composition of Growth by Sector of Economic Activity
on Unemployment in Mexico, by Regions in 1996-2001

	Total Unemployment	Urban Unemployment	Rural Unemployment
Primary Sector	-6.285906	-3.0522	-7.762307*
T-statistics	(-0.82)	(-0.49)	(-2.19)
Mid-point elasticity	[-0.622]	[-0.337]	[-7.321]
Secondary Sector	-8.067314**	-7.174189**	-0.8417971
T-statistics	(-1.77)	(-1.94)	(-0.4)
Mid-point elasticity	[-2.057]	[-2.043]	[-2.046]
Tertiary Sector	2.533128	1.500721	1.943555
T-statistics	(0.75)	(0.55)	(1.25)
Mid-point elasticity	[1.690]	[1.118]	[12.362]

Note: At the mid-points, the share of the primary sector in total GDP is 0.099; the share
of the secondary sector is 0.255, while the share of the tertiary sector is 0.646. The
share of urban unemployment is 0.895 whereas the share of rural unemployment
is 0.105.

* Coefficients statistically significant at the 5% level.

** Coefficients statistically significant at the 10% level.

Source: Calculated from NES, 1996-2001.

TABLE 6

GDP Shares and Regional Unemployment for Mexico (%), 1996-2001

Region	Sectors shares in GDP			Urban and rural shares in total unemployment	
	Primary	Secondary	Tertiary	Urban	Rural
Northeast	4.6	33.6	63.8	93.1	6.9
Northwest	12.0	22.3	68.0	84.5	15.5
Central-South	5.0	34.0	62.0	92.0	8.0
South	18.1	18.5	64.6	81.4	18.6
Southeast	17.8	11.3	72.3	91.7	8.3
West	11.9	24.4	65.7	94.4	5.6
Central-North	7.4	32.0	61.9	86.1	13.9
East	9.3	30.5	61.4	85.1	14.9
North	12.5	24.9	64.0	87.3	12.7
Central	2	23.5	83.4	99.5	0.5

Source: Calculated from NES, 1996-2001.

From the data shown in Table 7 one can see that the elasticities for total unemployment with respect to growth in the secondary sector are larger in absolute terms for regions where the shares of GDP of the secondary sector are also larger (Northeastern, Central-South and Central-North regions). Also, those same regions show the largest elasticities of urban unemployment with respect to growth in the secondary sector.

The data in Table 7 also show that the elasticities for rural unemployment with respect to growth in the primary sector are larger in regions where the shares of the primary sector in total GDP are larger (or where the shares of rural unemployment are smaller). Such is the case for the Southeastern and Western regions.

TABLE 7
Regional Elasticities of Unemployment with respect
to Economic Growth (%)

Region	Total Change	Urban	Rural
Primary Sector			
Northeast	-0.757	-0.435	-6.030
Central-South	-0.317	-0.167	-4.894
South	-1.138	-0.679	-7.540
Southeast	-1.118	-0.592	-16.700
West	-0.747	-0.384	-16.576
Central-North	-0.465	-0.262	-4.126
East	-0.586	-0.334	-4.850
North	-0.787	-0.437	-7.678
Central	-0.014	-0.007	-3.106
Secondary Sector			
Northeast	-1.801	-1.896	-1.213
Central-South	-2.743	-2.651	-3.579
South	-1.490	-1.629	-0.834
Southeast	-0.912	-0.884	-1.150
West	-1.967	-1.853	-3.687
Central-North	-2.581	-2.666	-1.935
East	-2.457	-2.568	-1.719
North	-2.008	-2.045	-1.656
Central	-1.898	-1.697	-36.540
Tertiary Sector			
Northeast	1.722	1.208	8.529
Central-South	1.570	1.011	15.063

Region	Total Change	Urban	Rural
South	1.636	1.191	6.735
Southeast	1.832	1.183	16.995
West	1.665	1.045	22.944
Central-North	1.567	1.079	8.641
East	1.556	1.083	8.003
North	1.621	1.100	9.830
Central	2.112	1.258	298.966

Source: Calculated from NES, 1996-2001.

We applied the Wald test under the null hypothesis that the secondary sector growth has the same effect on total unemployment as do the growth of the primary and tertiary sectors, and it was rejected for all cases (see Tables A3 and A4 in the Appendix). We also found that none of the economic sectors' growth had any significant effect on rural-urban population changes (equation 10).

■   *Concluding remarks*

Empirical evidence shows that economic growth has a negative effect on the open rate of unemployment and that the sector composition of economic growth is very important for reducing unemployment in Mexico. On the basis of panel data for the 1996-2001 period, we estimated regional unemployment and *per capita* GDP for the period, and found an elasticity of total unemployment with respect to growth in the secondary sector of -2.06, meaning that a one percent increase in the product of the secondary sector is associated to a fall of two percent in the rate of growth of total unemployment. We also found that for the urban areas, the elasticity of urban unemployment with respect to growth in the secondary sector was -2.04, whereas for rural areas, the elasticity of rural unemployment with respect to growth in the primary sector was -7.32. We found no significant effects of sectoral growth on rural-urban migration among the ten Mexican regions.

Regionally, we found that the elasticities of total (and also urban) unemployment with respect to growth in the secondary sector are larger in absolute terms for regions where the secondary sector's shares of GDP are larger. That is the case for the Northeastern, Central-South and Central-North regions. Also, we found that the elasticities for rural unemployment with respect to growth in the primary sector are larger in regions where the shares of the primary sector in total GDP are larg-

er, or where the shares of rural unemployment are smaller. Such is the case for the Southeastern and Western regions.[27]

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27. One of the limitations of this study, which follows a general equilibrium approach, is that it does not look into the causes of economic growth; that is, if growth comes out from labor or from capital intensive activities, which clearly would have a differential impact on employment. Another limitation is that it did not estimate the elasticity of product growth with respect to wages, and therefore does not look upon the flexibility of the labor markets. Yet another limitation is that it does not offer any conclusions about the economic effects of interregional migration.

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■ *Appendix 1*
Supporting Statistical Analysis

TABLE A1
Regionalization of Mexico by INEGI

Region	State Capital	Circunscripción
1 Northeast	Monterrey, NL	Nuevo León, Coahuila, and Tamaulipas
2 Northwest	Hermosillo, Son.	Sonora, Baja California, B. C. Sur, and Sinaloa
3 Central-South	Toluca, Edo. de Méx.	México, Guerrero, and Morelos
4 South	Oaxaca, Oax.	Oaxaca, Chiapas, and Tabasco
5 Southeast	Mérida, Yucatán.	Yucatán, Campeche, and Quintana Roo
6 West	Guadalajara, Jal.	Jalisco, Colima, Michoacán, and Nayarit
7 Central-North	San Luis Potosí, SLP	SLP, Aguascalientes, Guanajuato, and Querétaro
8 East	Puebla, Pue.	Puebla, Hidalgo, Tlaxcala, and Veracruz
9 North	Durango, Dgo.	Durango, Chihuahua, and Zacatecas
10 Central	México, DF	Distrito Federal

Source: Calculated from NES, 1996-2001.

Table A2
Regional Estimates of Total, Urban and Rural Unemployment (%):
Mexico, 1996-2001

Region		Year	Total	ee	Urban	ee	Rural	ee
Northeast	1	1996	2.84	0.24	3.09	0.30	1.96	0.29
	1	1997	2.44	0.27	2.48	0.70	2.34	0.26
	1	1998	2.04	0.19	2.24	0.33	1.30	0.22
	1	1999	1.48	0.12	1.72	0.23	0.69	0.14
	1	2000	1.68	0.15	1.82	0.25	1.05	0.17
	1	2001	1.48	0.13	1.59	0.12	1.00	0.47
Central-South	2	1996	5.10	0.32	6.02	0.32	1.70	0.39
	2	1997	3.22	0.51	3.66	0.52	1.79	0.64
	2	1998	2.91	0.25	3.33	0.67	1.45	0.23
	2	1999	2.32	0.31	2.91	0.03	0.04	0.37
	2	2000	1.92	0.15	2.15	0.22	0.85	0.18
	2	2001	1.86	0.16	2.21	0.19	0.21	0.14
South	3	1996	1.54	0.14	2.72	0.13	0.54	0.23
	3	1997	1.00	0.32	1.82	0.31	0.27	0.52
	3	1998	1.37	0.35	2.47	0.14	0.43	0.50

Region		Year	Total	ee	Urban	ee	Rural	ee
	3	1999	0.99	0.13	1.74	0.15	0.29	0.20
	3	2000	1.07	0.20	1.58	0.30	0.59	0.23
	3	2001	1.17	0.18	1.79	0.28	0.55	0.17
Southeast	4	1996	2.18	0.20	2.61	0.21	0.57	0.26
	4	1997	1.79	0.29	1.95	0.09	0.82	0.33
	4	1998	1.23	0.12	1.48	0.13	0.36	0.15
	4	1999	1.09	0.18	1.16	0.54	0.82	0.18
	4	2000	1.05	0.11	1.21	0.18	0.40	0.12
	4	2001	1.08	0.10	1.21	0.12	0.53	0.17
West	5	1996	2.80	0.17	3.44	0.23	0.83	0.19
	5	1997	1.80	0.25	2.39	0.23	0.33	0.23
	5	1998	1.53	0.11	1.91	0.13	0.21	0.11
	5	1999	1.42	0.20	1.71	0.20	0.47	0.25
	5	2000	1.32	0.12	1.59	0.10	0.28	0.14
	5	2001	1.27	0.11	1.48	0.13	0.48	0.15
Central-North	6	1996	3.05	0.23	3.90	0.52	1.25	0.22
	6	1997	1.72	0.28	2.42	0.55	0.65	0.30
	6	1998	1.73	0.17	2.08	0.35	0.85	0.19
	6	1999	1.43	0.17	1.74	0.20	0.66	0.22
	6	2000	1.38	0.18	1.70	0.23	0.64	0.23
	6	2001	1.48	0.13	1.85	0.16	0.61	0.18
East	8	1996	2.91	0.43	4.03	0.25	1.08	0.59
	8	1997	2.93	0.68	3.76	0.01	1.68	0.72
	8	1998	1.94	0.28	2.52	0.33	0.96	0.36
	8	1999	1.32	0.18	2.04	0.08	0.25	0.26
	8	2000	1.43	0.13	1.99	0.11	0.46	0.17
	8	2001	1.53	0.18	1.82	0.16	1.00	0.41
North	9	1996	3.11	0.26	3.86	0.40	1.27	0.36
	9	1997	1.51	NA	2.14	0.01	0.24	NA
	9	1998	1.71	0.14	2.08	0.30	0.85	0.19
	9	1999	1.41	0.17	1.73	0.15	0.62	0.21
	9	2000	1.17	0.10	1.29	0.22	0.83	0.12
	9	2001	2.27	0.16	2.75	0.13	0.78	0.50
Central	10	1996	7.04	0.40	7.02	1.22	8.39	0.40
	10	1997	4.68	0.50	4.71	NA	2.60	0.50
	10	1998	4.03	0.34	4.03	0.81	03.49	0.34
	10	1999	3.20	0.73	3.20	0.10	2.15	0.73
	10	2000	2.91	0.25	2.92	0.19	2.48	0.25
	10	2001	3.04	0.31	3.04	0.32	1.94	0.43

Source: Calculated from NES, 1996-2001.

NA: Not available.

TABLE A3

Estimates of Changes in Unemployment as a Function of the Sectoral Composition of Economic Growth for 32 Mexican States in 1996-2001 (Panel estimated through Fixed Effects)

| Variable or Parameter	Total	Urban	Rural	Population Change βn
Primary Sector β_1	4.774	2.497	2.681**	-0.424
	(1.47)	(0.96)	(1.89)	(-1.17)
Secondary Sector β_2	1.073	-0.683	-0.103	-0.478
	(0.33)	(-0.26)	(10.07)	(-1.3)
Tertiary Sector β_3	-6.573*	-4.22**	-0.544	-0.116
	(-2.2)	(-1.76)	(-0.4)	(-0.35)
R^2	0.176	0.169	0.0765	0.1166
Functional Form (Reset) F(3, 149)	0.55	0.88	6.56	2.38
	[0.6509]	[0.4505]	[0.04]	[0.072]
Wald $\beta_1=\beta_2=\beta_3$ F(2, 152)	2.67	1.58	1.97	0.19
	[0.0728]	[0.2088]	[0.1434]	[0.8234]
HeteroscedasticityChi-sq(25)	12.93704	21.72134	43.76894	29.55236
	[0.9773]	[0.6518]	[0.0115]	[0.2415]

Note: T-values inside parentheses; p-values inside brackets.
* Coefficients statistically significant at the 5% level
** Coefficients statistically significant at the 10% level
Source: Calculated from NES, 1996-2001.

FIGURE A1
Regional Rates of Growth of Gross Domestic Product
and Unemployment for Mexico, 1996-2001
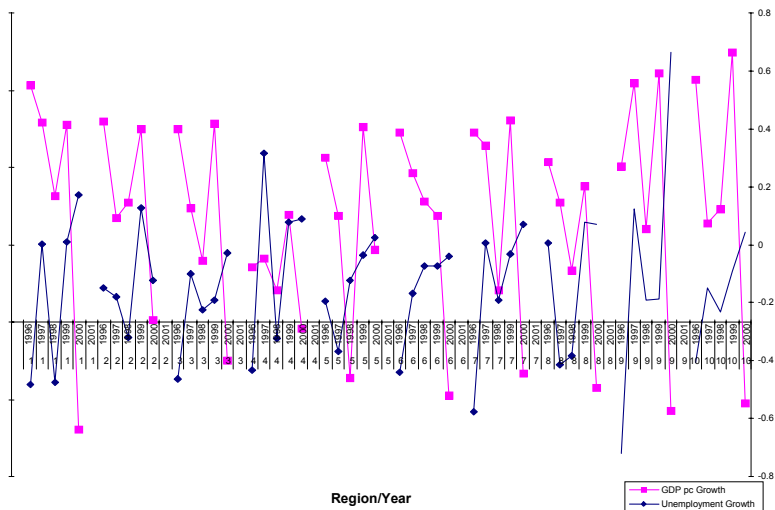
Source: Calculated from NES, 1996-2001.

TABLE A4

Estimates of Changes in Unemployment as a Function of the Sectoral
Composition of Economic Growth for Ten Mexican Regions in 1996-
2001 (Panel estimated through Fixed Effects)

Variable or Parameter	Total	Urban	Rural	Population Change βn
Primary Sector β_1	-6.286	-3.052	-7.762	0.557
	(-0.82)	(-0.49)	(-2.19)*	(0.49)
Secondary Sector β_2	-8.067	-7.174	-0.841	-0.815
	(-1.77)**	(-1.94)**	(-0.4)	(-1.20)
Tertiary Sector β_3	2.533	1.5	1.943	0.326
	(0.75)	(0.55)	(1.25)	(0.65)
R^2	0.522	0.537	0.248	0.272
Functional Form F(3, 149)	2.62	2.86	4.26	2.43
	[0.0645]	[0.0492]	[0.0108]	[0.08]
Wald $\beta_1=\beta_2=\beta_3$	1.16	1.32	2.9	1.33
	[0.3239]	[0.2773]	[0.0664]	[0.2745]
Heterocedasticity Chi-sq(25)	26.16224	28.38335	42.48411	15.8989
	[.399]	[0.2905]	[0.0159]	[0.9178]

Note: T-values inside parentheses; p-values inside brackets.
* Coefficients statistically significant at the 5% level
** Coefficients statistically significant at the 10% level
Source: Calculated from NES, 1996-2001.