Sources of Change in State-Level Agricultural Production in Mexico: Implications from the Peso Crisis of 1994-1995

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In late December 1994 the Mexican government was unable to defend its currency against the U.S. dollar due to a flight of foreign reserves sparked by mounting political uncertainty at home and rising interest rates in the United States (Gould and Gruben 1995). This led to the devaluation of the Mexican peso, which lost close to 40 percent of its value by February 1995 (Taylor and Harris 1995), and to the worst economic crisis[1] in Mexico in more than sixty years (Vargas 1999).

According to international trade theory, currency devaluations lead to changes in a nation's productive capacity. In general, devaluations cause the economy to shift production from non-traded or purely domestic goods to import substitutes and export products (Salvatore, 1987).

Several studies have documented the theory's prediction with respect to the case of the Mexican peso crisis of 1994–1995. Vargas (1999) noted that despite external problems[2], Mexico's gross domestic product grew at a respectable 4.8 percent in 1998. Gruben (2000) added that the driving force behind Mexico's growth since 1995 has been exports.

The primary objective of this paper is to investigate how events such as currency devaluations affect production at the regional level. While the theory predicts that production in general will shift from domestic/non-traded goods to import substitutes/export goods, how do these production shifts affect specific economic sectors at the sub-national level? Specifically, this paper looks at changes in state-level agricultural production[3] that have taken place in Mexico's thirty-two states from 1993 to 2000[4]. This paper seeks to identify whether the changes in agricultural production over this period are attributable to national or local economic conditions.

Shift-share analysis is used to analyze change in production. While this descriptive technique does not offer any clarification regarding causality (Sihite et al. 1990) between currency devaluations and shifts in agricultural production, it permits examination of how structural and competitive forces allow agricultural production at the state level to perform differently from national production. This is achieved by disaggregating the change in production into several smaller components.

The primary benefit derived from this study is the determination of whether the changes in agricultural production have allowed states to exhibit comparative advantages. This would provide appropriate information to policy makers in their development of policies affecting the agricultural sector in their respective jurisdictions.

State-level Agricultural Production in Mexico

Based on data obtained from INEGI[5] (2002), the country's real gross domestic product increased by 27.7 percent between 1993 and 2000. In light of the fact that Mexico's economy contracted in 1995 by 6.2%, the average annual real GDP growth

[1] Mexican gross domestic product slid by 6.17 percent from 1.21 trillion pesos in 1994 to 1.13 trillion pesos in 1995 (INEGI 2002).

[2] External problems that Vargas (1997) noted as having impacts on Mexico's recovery in the aftermath of the 1994-1995 peso crisis were the contagion effects of the Asian financial crisis of 1997-1998 and the Russian debt default in August 1998 and a drop in oil prices in 1997–1998 that affected Mexico's government revenues.

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[3] For the purpose of this study, industrial production is based on INEGI's definition of gross value added. Gross value added is defined as gross domestic product less taxes. Production is measures in terms of 1993 pesos.

[4] The period from 1993 to 2000 represents the most comprehensive state-level information available from INEGI.

[5] INEGI is an agency of the Mexican government that is responsible for national statistical systems and geographic information.

rate was estimated at approximately 3.6% over the eight-year period.

Mexico's agriculture sector has contributed close to 6.1% of the nation's annual GDP. From 1993 to 2000 this sector grew by 11.6%. Despite the 1995 economic contraction that resulted from the devaluation of the Mexican peso, the value of agricultural production at the national level steadily increased at an average annual growth rate of 1.6% over the period under consideration.

At the state level, the value of agricultural production has followed an upward trend from 1993 to 2000 for a majority of the country's 32 states. This sector, which comprises close to 9.26% of the average state's gross state product, has experienced an annual average growth rate of 1.7% over the eight-year period (Table 1).

Data and Procedures[6]

The data used in this study was derived from INEGI (2002). State- and national-level agricultural production and GDP values from 1993 to 2000, measured in 1993-peso terms, were used in estimating the shift-share components.

To assess the temporal nature of components of change in the value of state-level agricultural production, two time periods were used in this analysis to represent the pre- and post- peso-crisis periods in the Mexican economy. The pre-crisis and post-crisis periods correspond to 1993–1995 and 1996–2000, respectively.

The use of shift-share analysis in the economics literature has been prolific (Kochinowski, Bartholomew, and Joray 1989; Richardson 1979; Webb 1996). This is primarily due to the simplicity in calculation and data requirements. This descriptive technique breaks down the change in an economic variable into several smaller components or sources of change.

In the traditional version of shift-share analysis, change in an economic variable is broken down into three components. One portion of the change is attributed to growth trends in all industries at the national level (*national-growth component*). Other portions of the change are ascribed to growth trends in the specific industry at the national level (*industry-mix effect*) and to growth trends in the specific industry at the local level (*comparative-shift effect*).

Several studies (Kochinowski, Bartholomew, and Joray 1989; Sihite et al. 1990; Webb 1996) have noted a deficiency with the traditional version of the shift-share model. In its current form, the model does not accurately apportion the charge in an economic variable to the component-shift effects. They have indicated that a variation of the model corrects for this deficiency.

This study made use of the *Esteban-Marquillas* (EM) version of the shift-share model[7]. Rather than disaggregating the change in an economic variable into three components, this version breaks down the change into four components. The first component, the *national-growth component*, attributes a portion of the change in the value of state-level agricultural production to national economy-wide growth trends. This change in production is that change which would have taken place if a state's agriculture sector grew at the same rate as the national economy.

The second component of this modified shift-share model is the *industry-mix effect.* This component measures the change in the value of state-level agricultural production that is due to national-level changes in agricultural production. A positive industry-mix effect means that the state's agriculture sector has grown at above-average national agricultural-production growth rates (rapid-growth industry). If a state's agricultural sector has grown at below national-average rates, this would provide us with a negative industry-mix effect and is considered to be slow-growth state-level industry.

The residual portions of change in state-level agricultural production are attributed to two components: *competitive* and *allocation effects*. These component effects determine the influence of the state's economy's characteristics on change in agricultural production.

The competitive effect measures the change in the value of production that is due to the state economy's comparative advantage/disadvantage with respect to agricultural production. This advantage (disadvantage) exists when the growth rate of

[6] See Ray (1995) and Webb (1996) for the mathematical derivation of the Esteban-Marquillas version of the shift-share model.

[7] Ray (1995) noted that the structure of the Esteban-Marquillas version of the shift-share model is an appropriate procedure if the goal is the identification of competitive advantage in a region's economic sectors.

Table 1. Value of Agricultural Production in Mexico's GDP, 1993–2000.

State	1993	1994	1995	1996	1997	1998	1999	2000
	(millions of 1993 pesos)							
Aguascalientes	650	618	759	790	686	726	740	743
Baja California	1,187	1,140	1,402	1,402	1,545	1,587	1,586	1,449
Baja California Sur	554	527	598	642	682	531	564	592
Campeche	628	688	600	751	664	753	726	810
Chiapas	3,276	3,098	3,178	3,233	3,283	3,301	3,769	3,836
Chihuahua	3,593	3,415	3,472	3,865	4,860	4,283	4,297	3,902
Coahuila	1,648	1,613	1,813	1,629	1,685	1,806	1,789	1,836
Colima	609	546	548	637	637	684	698	743
Distrito Federal	386	373	415	378	418	384	378	404
Durango	2,597	2,677	2,714	2,938	2,529	2,780	2,596	2,795
Guanajuato	3,738	3,648	3,621	3,715	3,434	3,664	3,344	3,437
Guerrero	3,114	2,047	2,291	2,320	2,056	2,345	2,568	2,577
Hidalgo	1,535	1,610	1,612	1,748	1,623	1,504	1,623	1,848
Jalisco	6,017	6,111	6,032	6,348	6,288	7,274	7,050	6,920
Mexico	2,965	3,027	3,161	3,572	3,862	3,962	4,697	4,689
Michoacan	4,544	4,736	4,928	5,016	6,105	5,799	6,430	6,025
Morelos	1,949	2,027	1,979	1,960	1,795	1,667	1,971	2,061
Nayarit	1,552	1,483	1,355	1,446	1,434	1,447	1,568	1,616
Nuevo Leon	1,068	1,228	1,425	1,465	1,409	1,620	1,392	1,284
Oaxaca	3,102	2,924	2,978	3,008	2,884	3,126	3,201	3,253
Puebla	3,037	2,831	2,950	3,054	2,898	2,939	3,323	3,308
Queretaro	696	782	803	754	750	868	742	803
Quintana Roo	275	246	204	249	211	213	256	178
San Luis Potosi	2,282	2,400	1,895	1,928	1,880	2,217	2,094	2,082
Sinaloa	5,779	5,261	5,628	5,713	5,999	6,054	5,672	6,135
Sonora	4,211	4,483	4,565	4,794	4,571	4,597	4,535	4,070
Tabasco	1,055	1,207	1,211	1,154	1,124	1,030	1,113	1,199
Tamaulipas	2,714	3,077	2,837	3,006	2,472	2,605	2,453	2,345
Tlaxcala	496	496	493	499	468	443	402	555
Veracruz	4,857	5,081	5,218	5,327	5,446	5,414	5,516	5,706
Yucatan	1,179	1,141	1,134	1,136	1,107	1,037	1,081	1,148
Zacatecas	2,393	2,218	2,331	2,492	2,282	2,760	2,439	2,765
Mexico (Ag)	72,702	72,833	74,168	76,983	77,105	79,438	80,627	81,128
Mexico GDP								

agricultural production at the state-level surpasses (lags behind) the growth rate of the same industry at the national level. Comparative advantage (disadvantage) is represented by a positive (negative) competitive effect value.

On the other hand, the allocation effect identifies whether a state is specialized in the industry (agriculture) wherein it enjoys a comparative advantage. This is evidenced by the amount of the change in production that is reflective of the size of a state's agriculture sector in relation to the same industry at the national level.

The allocation effect can take on a positive or negative value. Interpretation of the signs is determined in conjunction with the corresponding competitive effect. Table 2 provides a matrix of possible interpretations for the allocation effect.

Results

Results of the shift-share analyses are provided in Tables 3 and 4 for 1993–1995 and 1996–2000, respectively. An examination of the results reveals that significant differences in the sources of change between the two periods under consideration.

1993–1995

Given the 2-percent decline in Mexico's GDP from 1993 to 1995, it was expected that the national growth component of change in state-level agricultural production would decline. For all of the thirty-two states, the decrease in agricultural production that was attributed to national economic conditions did not account for a significant share of change in production. The percentage share of the national growth component ranged from 0.42 percent (Distrito Federal) to 25.84 percent (Jalisco).

National growth trends in agricultural production (industry-mix effect) contributed positively to changes in agricultural production for all the states in Mexico. The positive industry-mix effects reveal that agricultural production was a fast-growth industry for these states. In fact, this effect represented the largest share of change in the value of agricultural production for 15 of the 32 states.

In terms of the competitive effect, half of the states exhibited positive values. This meant that these states displayed comparative advantages in agricultural production. The competitive effect contributed a significant portion to the change in value of agricultural production for 10 of the 16 states that experienced comparative advantages. Based on information from Table 3, six states—wherein the competitive effect accounted for a major share of the change in agricultural production values—showed comparative disadvantaged (negative competitive effects).

As noted in Table 2, interpretation of the allocation effect is conducted in conjunction with the competitive effect. In 1993–1995, only 9 states were specialized and exhibited comparative advantages in agricultural production. For 14 states, agricultural production was specialized but did not display comparative advantages.

Table 2. Interpretations of the Allocation Effect.

Sign of the Competitive Effect	Sign of the Allocation Effect	Interpretation
+	+	The regional industry is specialized and has a comparative advantage.
+	-	The regional industry is not specialized but has a comparative advantage.
-	+	The regional industry is not specialized and has a comparative disadvantage.
-	-	The regional industry is specialized but has a comparative disadvantage.

Source: Webb (1996).

Table 3. Shift-Share Components for Contributions of Agriculture to State-Level GDP (1993-1995).

State	National Growth Component		Industry Mix Effect		Competitive Effect		Allocation Effect	
	Million Pesos	%	Million Pesos	%	Million Pesos	%	Million Pesos	%
Aguascalientes	-13.16	8.64	26.27	17.25	104.45	68.58	-8.42	5.53
Baja California	-24.03	4.48	47.96	8.95	327.73	61.15	-136.21	25.42
Baja California Sur	-11.22	16.83	22.40	33.58	23.18	34.76	9.89	14.83
Campeche	-12.72	11.68	25.39	23.30	-55.75	51.17	15.10	13.85
Chiapas	-66.31	18.33	132.33	36.58	-64.71	17.89	-98.44	27.21
Chihuahua	-72.73	17.69	145.16	35.31	-153.00	37.22	-40.16	9.77
Coahuila	-33.36	10.93	66.57	21.81	168.55	55.22	-36.76	12.04
Colima	-12.35	11.10	24.64	22.16	-48.67	43.78	-25.51	22.95
Distrito Federal	-7.82	0.42	15.61	0.83	936.82	49.93	-916.01	48.82
Durango	-52.58	23.69	104.93	47.27	23.42	10.55	41.04	18.49
Guanajuato	-75.68	18.05	151.03	36.02	-125.76	30.00	-66.78	15.93
Guerrero	-42.80	16.33	85.43	32.59	86.19	32.88	47.74	18.21
Hidalgo	-31.07	22.22	62.01	44.35	33.38	23.88	13.35	9.55
Jalisco	-121.80	25.84	243.08	51.58	-84.39	17.91	-22.03	4.68
Mexico	-60.02	8.19	119.79	16.34	344.70	47.01	-208.78	28.47
Michoacan	-91.99	16.22	183.59	32.37	109.05	19.23	182.46	32.17
Morelos	-39.45	31.10	78.74	62.07	-4.81	3.79	-3.85	3.04
Nayarit	-31.41	9.75	62.70	19.47	-70.45	21.88	-157.51	48.90
Nuevo Leon	-21.62	0.81	43.15	1.62	1466.82	55.10	-1130.73	42.47
Oaxaca	-62.80	16.78	125.33	33.48	-72.64	19.41	-113.52	30.33
Puebla	-61.48	18.48	122.71	36.88	-114.91	34.53	-33.64	10.11
Queretaro	-14.09	6.33	28.13	12.64	136.84	61.7	-43.54	19.56
Quintana Roo	-5.57	1.22	11.11	2.43	-258.63	56.50	182.48	39.86
San Luis Potosi	-46.20	8.09	92.20	16.14	-243.82	42.69	-188.97	33.08
Sinaloa	-116.98	18.92	233.47	37.77	-78.41	12.68	-189.34	30.63
Sonora	-85.25	16.26	170.13	32.44	121.18	23.11	147.82	28.19
Tabasco	-21.37	10.78	42.65	21.52	118.81	59.96	15.33	7.73
Tamaulipas	-54.95	23.67	109.66	47.24	50.50	21.76	17.01	7.33
Tlaxcala	-10.04	23.50	20.04	46.91	-9.40	22.00	-3.24	7.59
Veracruz	-98.31	17.62	196.21	35.17	179.86	32.24	83.57	14.98
Yucatan	-23.88	17.04	47.66	34.01	-54.99	39.24	-13.59	9.70
Zacatecas	-48.45	19.00	96.69	37.91	-28.00	10.98	-81.90	32.11

Note: The monetary values are in 1993 constant pesos.

Table 4. Shift-Share Components for Contributions of Agriculture to State-Level GDP (1996-2000).

Region/State	National Growth Component		Industry Mix Effect		Competitive Effect		Allocation Effect	
	Million Pesos	%	Million Pesos	%	Million Pesos	%	Million Pesos	%
Aguascalientes	188.97	43.71	-146.43	33.87	-93.01	21.51	3.91	0.90
Baja California	335.42	50.94	-259.90	39.47	-45.60	6.93	17.54	2.66
Baja California Sur	153.77	43.02	-119.15	33.34	-58.59	16.39	-25.92	7.25
Campeche	178.80	51.94	-139.32	40.25	22.73	6.57	-4.31	1.24
Chiapas	773.41	42.94	-599.30	33.27	185.51	10.30	242.97	13.49
Chihuahua	924.47	51.02	-716.35	39.53	-138.49	7.64	-32.70	1.80
Coahuila	389.68	42.13	-301.95	32.65	176.54	19.09	-56.78	6.14
Colima	152.36	44.41	-118.06	34.41	51.46	15.00	21.19	6.18
Distrito Federal	90.55	13.48	-70.17	10.45	258.20	38.45	-252.67	37.62
Durango	702.92	45.38	-544.67	35.16	-105.22	6.79	-196.31	12.67
Guanajuato	888.79	43.22	-688.70	33.49	-335.48	16.31	-143.47	6.98
Guerrero	554.94	49.67	-430.01	38.49	79.83	7.15	52.47	4.70
Hidalgo	418.24	55.88	-324.08	43.30	3.956	0.53	2.22	0.30
Jalisco	1518.59	51.93		40.24	176.34	6.03	52.87	1.81
Mexico	854.52	18.07	-662.14	14.00	2067.80	43.74	-1143.52	24.19
Michoacan	1199.97	41.84	-929.83	32.42	276.67	9.65	461.68	16.10
Morelos	468.98	56.01	-363.40	43.40	-2.66	0.32	-2.25	0.27
Nayarit	345.88	48.93	-268.01	37.92	29.87	4.23	63.08	8.92
Nuevo Leon	350.57	16.53	-271.65	12.81	-878.94	41.45	619.19	29.20
Oaxaca	719.55	52.91	-557.56	41.00	34.55	2.54	43.38	3.56
Puebla	730.49	52.69	-566.04	40.83	74.16	5.35	15.81	1.14
Queretaro	180.54	53.58	-139.90	41.52	12.062	3.58	-4.44	1.32
Quintana Roo	59.62	8.37	-46.19	6.48	-345.45	48.49	261.20	36.66
San Luis Potosi	461.17	53.06	-357.34	41.11	35.07	4.04	15.58	1.79
Sinaloa	1366.56	53.80		41.69	34.58	1.36	80.10	3.15
Sonora	1146.88	37.99	-888.68	29.44	-433.59	14.36	-549.38	18.20
Tabasco	276.19	54.37	-214.01	42.13	-15.42	3.03	-2.40	0.47
Tamaulipas	719.11	34.25	-557.22	26.54	-613.40	29.22	-209.66	9.99
Tlaxcala	119.47	49.49	-92.57	38.35	24.41	10.11	4.95	2.05
Veracruz	1274.20	54.14	-987.35	41.95	61.82	2.63	30.28	1.29
Yucatan	271.74	51.19	-210.57	39.66	-43.41	8.18	-5.18	0.98
Zacatecas	596.07	49.79	-461.88	38.58	35.83	2.99	103.41	8.64

Note: The monetary values are in 1993 constant pesos.

1996–2000

In the post-currency-devaluation period, Mexico's GDP grew by approximately 24 percent. This represented an annual average growth rate of 5.44 percent. This rejuvenated condition of the national economy played a considerable role in the change in state-level agricultural production over this period. All of the states exhibited positive national-growth components over the 1996–2000 period. Furthermore, except for the states of Nuevo Leon, Distrito Federal, Mexico, and Quintana Roo, this shift-share component represented the foremost factor for change in agricultural production at the state level.

In terms of the industry-mix effect, all of the states displayed negative values. This meant that agricultural production has become a slow-growth industry at the sub-national level. In comparing the industry-mix values for the two periods, why has agricultural production shifted from a fast-growth to a slow-growth industry? Is it possible that resources at the state level have been redirected toward the production of export goods and import substitutes?

As far as the competitive effect is concerned, the number of states that have exhibited comparative advantages in agricultural production increased from 16 in 1993–1995 to 19 in 1996–2000. It should be noted that, unlike in the earlier period, the competitive effect has not been a significant factor in the change in agricultural production in the later period.

The number of states that were specialized and exhibited comparative advantages in agricultural production increased from 9 in 1993–1995 to 14 in 1996–2000. The number of states that were specialized but did not show comparative advantages declined from 14 to 8. As with the case of the competitive effect, the allocative-effect component did not represent a significant influence on the change in state-level agricultural production in the 1996–2000 period.

Summary

The purpose of this paper was to examine changes in state-level agricultural production in Mexico. This study attempted to distinguish, using shift-share analysis, whether changes in the agricultural production at the sub-national level were due to national growth trends or regional competitive advantage.

Prior to the currency crisis of late 1994-early 1995, changes in state-level agricultural production were dominated by national trends in agricultural production and competitive factors that were indigenous to the states. The larger percentage shares of the industry-mix and competitive effects at the state-level as compared to the national-growth component and the allocation effect evidenced these.

As the nation came out of the economic crisis in the succeeding years, an invigorated national economy played a considerable role in the changes in state-level agricultural production. The national-growth component accounted for approximately half of the change in agricultural production for most of the states. In addition, national trends in agricultural production have impacted sub-national industry-mix effects. The negative industry-mix effect values signaled that agricultural production has become a slow-growth industry for the states. This could signal that state economies may be shifting resources to other sectors. Such a statement is made merely as an observation, in light of the fact that the method of analysis used in this study does not provide any evidence of causality.

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