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Article

Spatial and vertical transmission of milk prices from the international market to Mexico's regional and national markets

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Abstract:

When a country imports a good or service, it is subject to prices determined by the world market; therefore, domestic market prices change when international prices do. This study aimed to estimate the degree of price transmission between the producer price of milk in Mexico at the national and regional levels and that of the United States (spatial transmission) and between the retail price of milk and the producer price in Mexico (vertical transmission). An econometric analysis of monthly time series of milk prices from January 1990 to December 2021 was performed, applying unit root tests, cointegration tests, and an error correction vector model. The results indicate that there is a long-term relationship between United States prices and producer prices at the national and regional levels, as well as between the retail price and the producer price. It was found that the spatial transmission of international prices to the producer price at the national level and in the regions of Jalisco and Veracruz is symmetrical and asymmetrical with the producer price in the state of Coahuila. There are differences between regions in the speed of adjustment when international prices increase and when they decrease. The vertical transmission was also symmetrical, unidirectional, from the producer to the retail market, and incomplete.

Keywords: Price transmission, Milk market, Error correction model.

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Introduction

Historically, Mexico has been an importer of powdered milk because domestic production is insufficient to cover domestic demand. In 2022, imports accounted for 23.3 % of national consumption(1). In 2021, imports of powdered milk represented 40 % of the total value of dairy imports. Mexico's main supplier of these imports is the United States(2,3,4). For the national dairy subsector, imports historically exceed exports, i.e., the trade balance is in deficit(2,3).

When a country imports a good, it is subject to prices determined by the world market; therefore, domestic market prices change when international prices do. In an import scenario, those who benefit are the consumers, and these benefits represent a loss for the producer because the imported products are obtained in the international market at lower prices than what is paid in the domestic market(5,6). The United States can offer competitive prices of powdered milk to the international market since it has high productivity: the yield (liters of milk/cow/d) in Mexico in 2021 was 13.3, and for the United States in the same year, it was 29.78(7). In addition, both production and marketing in the United States receive high subsidies, which distorts product prices in world markets(3,8).

In Mexico, there is a high concentration of both production and industry. Fifty-three (53) percent of milk production is concentrated in four states, Jalisco (21 %), Coahuila (11.3 %), Durango (11.4 %), and Chihuahua (9.4 %)(2); within the milk chain, in the industrialization link, there are 130 companies that process 86 % of the national production, with an employed staff of 42 thousand people(9). The dairy industry is not only an important source of price change but also acts as a mediator of price signals originating from different parts of the food chain[10].

The national milk industry is an oligopoly characterized by a high degree of concentration of firms, significant barriers to entry, and dynamic product differentiation[11]. In the latter, prices determine the allocation of resources and the production decisions of economic agents[12].

Price transmission is the process through which information is transmitted between market participants[10]; its study allows to know if the markets are integrated. A theoretical framework used in the literature is the law of one price, which states that when there is a commercial exchange between two spatially separated regions, under conditions of perfect competition, price shocks in one market are transmitted completely and symmetrically to the other market and equilibrium prices differ only in transfer costs[13-16]. Markets that transmit price information quickly and comprehensively are said to be perfectly integrated and often efficient[13].

Specifically, price transmission studies analyze the form and speed of adjustment of domestic prices in the face of changes in international prices[14-17]. The speed with which prices are transmitted, the magnitudes of the transmission, and the non-linear behavior in the transmission of prices are indicators of market inefficiency[18].

The results obtained through a meta-analysis[19] suggest that asymmetric price transmission in producer-retailer relationships is more likely in sectors in countries with a more fragmented agricultural structure and greater government support. In Mexico, studies have been carried out on the transmission of fluid milk prices from the international market to the national market and even to the regional and local markets[14,15], but in a single geographical point, and there is no study of transmission in the largest producing regions, both spatial and vertical. This study aimed to estimate the degree of spatial transmission between United States milk import prices and the producer price of milk in Mexico at the national level and in the main producing regions and between the retail price of milk and the producer price at the national level (vertical transmission).

Material and methods

The econometric analysis performed used monthly time series of fluid milk prices from 1990:01 to 2022:12. The data for Mexico at both the national and regional levels are those paid to the producer (average rural price), obtained from the website of the Agri-Food and Fisheries Information Service of the Secretariat of Agriculture[20]. The regional prices correspond to those paid to the producer in the states of Jalisco, Coahuila, and Veracruz. The states that rank first in the production of bovine milk in their respective regions were selected; Jalisco is the first producing state in the Central-Western region and ranks first nationally (21 %), Coahuila is the first producing state in the Northeast region, ranking second nationally (11.8 %), and Veracruz is the first producing state in the South-Southeast region and ranks sixth nationally (6 %)[21].

The international milk price corresponds to the export prices of skimmed milk powder from the United States to Mexico, transformed into milk equivalent, obtained from the USDA-AMS website[22]. Consumer prices correspond to the average consumer price per liter of pasteurized fluid milk provided by the National System of Information and Integration of Markets[23] of the Secretariat of Economy and adjusted by the national consumer price index[24]. The price series were expressed in dollars per liter using the exchange rate published by the Bank of Mexico[25]. The data were transformed into natural logarithms in order to perform the econometric analysis and interpret the coefficients as elasticities.

The stationarity tests used were the Augmented Dickey-Fuller (ADF)[26] and Phillips-Perron (PP)[27] tests, with which the order of integration of each series was verified. The long-term relationship was then estimated using two-stage cointegration[28] and confirmed with the Johansen test[29]. Finally, it was estimated an Asymmetric Vector Error Correction Model (AVECM), a test to select the order of lag for an AVECM, and an F-test for equality of ECT+ and ECT- coefficients (positive and negative changes in the error term, respectively). The null hypothesis (H_0) of symmetry is rejected if β_2^+ and β_2^- (price adjustment coefficients) differ significantly.

Cointegration tests

The cointegration test was applied in both the spatial and vertical price transmission models. The cointegration between variables – once the existence of unit roots has been demonstrated – is a necessary condition for the existence of a long-term equilibrium relationship in the series. A vector of variables that have a unit root is cointegrated if a linear combination of these variables is stationary[26]. The two-step Engle-Granger cointegration test[28] and the Johansen test[29] were used to test the long-term relationship. The first approach is to estimate the cointegration regression (equation 1) using OLS:

$$p_t^{out} = a + b_1 p_t^{\text{in}} + m_t \qquad (1)$$

Where p_t^{out} is a firm's production price in period t, p_t^{in} and is the price of inputs in period t. The residual $\hat{U}_t$ is obtained from the cointegration regression, and an ADF unit root test is applied to it. The failure to reject the null hypothesis of non-stationarity allows us to estimate equation 2.

$$Dm_t = a + b_1 m_{t-1} + b_2 Dm_{t-1} \quad (2)$$

A negative coefficient of the error term (between -2 and zero) confirms a long-run relationship between the milk price paid to the producer and the international milk price. On the other hand, the Johansen test derived the distribution of two test statistics for the null hypothesis of non-cointegration: the tests of eigenvalues and trace[29]. Once the cointegration between prices was verified, an Error Correction Model (ECM) was applied to capture the short- and long-run effect of p_t^{in} on p_t^{out}, and the rate of adjustment at which p_t^{out} returns to equilibrium after a change in p_t^{in}.

Asymmetric spatial transmission of prices between international and domestic prices

Considering that producer and international prices are cointegrated, an Asymmetric Vector Error Correction Model (AVECM) was estimated to investigate the possible interdependence of import prices on domestic prices (spatial transmission). The division of the Error Correction Term (ECT) into positive and negative components allowed to verify the existence of asymmetric price transmission; following this approach, equation 3 was used to study spatial asymmetric price transmission[12].

$$\Delta p_t^{farm} = \alpha + \sum_{j=1}^{k} (\beta_j^{+} D^{+} \Delta p_{t-j+1}^{int}) + \sum_{j=1}^{L} \left(\beta_j^{-} D^{-} \Delta p_{t-j+1}^{int}\right) + \emptyset^{+} ECT_{t-1}^{+} + \emptyset^{-} ECT_{t-1}^{-} + \gamma_t \quad (3)$$

Where Δ is the first difference of the operator; P_t^{farm}= producer price; P_t^{int}=import price, D^+ and D^- are fictitious variables by means of which the price of inputs is divided into a variable that includes only increasing prices and another that includes only decreasing prices; β_j^{+} and β_j^{-} are price adjustment coefficients; $ø^{+}$ and $ø^{-}$ are constant parameters; ECT is the error correction term. An F-test was used to verify the null hypothesis of symmetry.

Asymmetric vertical price transmission

Equation 4 was used to estimate asymmetric vertical transmission and an F-test was used to verify the null hypothesis of symmetry[12].

$$\Delta p_t^{farm} = \alpha + \sum_{j=1}^{k} (\beta_j \Delta p_{t-j+1}^{int}) + \emptyset^{+} ECT_{t-1}^{+} + \emptyset^{-} ECT_{t-1}^{-} + \gamma_t \quad (4)$$

Results and discussion

According to the results of the ADF and PP unit root tests on the price series, the statistical value of t does not allow to reject the null hypothesis of unit root with a confidence level of 95 %, i.e., the price series are non-stationary (Table 1). Recent studies of milk price transmission obtained similar results of non-stationarity between time series[15,17,30]. The non-stationarity result of the time series justifies the use of cointegration tests. Cointegration allows a combination of non-stationary variables to be stationary. It can be seen as a long-term equilibrium relationship between variables despite the fact that in the short term, they go through situations of disequilibrium[31]. To determine if the series are cointegrated (long-term equilibrium), the residuals (u_t) of the cointegration regression must be stationary; this is achieved by applying the ADF test to determine the stationarity of the time series.

Table 1: Results of ADF and PP tests on the milk price series corresponding to imports, domestic producer, regional producer, and consumer

Price series	**ADF test**	**5% critical value**	**PP test**	**5% critical value**
Import price	-2.328	-3.425	-20.865	-21.406
Consumer price	-2.032	-3.425	-13.350	-21.406
Production price, National	-3.409	-3.425	-37.672	-21.406
Production price, Jalisco	-3.339	-3.425	-24.447	-21.402
Production price, Coahuila	-2.830	-3.425	-15.919	-21.402
Production price, Veracruz	-3.301	-3.425	-22.482	-21.402

Long-term co-integration of the national and regional spatial model

The results of the ADF test of the error term indicate that the null hypothesis of non-stationarity is rejected (Table 2), which means that the import price series is cointegrated in the long run with both the national and regional price series.

Table 2: Results of the ADF test of the error term

Price pairs	ADF test of the error	5% critical value
P^{Imp}-$P^{national\ prod}$	-4.174	-2.875
P^{Imp}-P^{Jal}	-3.450	-2.875
P^{Imp}-P^{Coah}	-3.344	-2.875
P^{Imp}- P^{Ver}	-3.598	-2.875

Engle and Granger[28] confirmed a long-term relationship between the producer milk price at the national level and the milk import price (Table 3), as well as between the producer price in Jalisco, Coahuila, and Veracruz and the international price (Table 4).

Table 3: Results of the two-step Engle-Granger cointegration test of the spatial model between the import price and the domestic producer price

Variable	Coefficient	Standard error	t-value	P>|t|
m_{t-1}	**-0.118624**	0.0179831	-6.60	0.000
Dm_{t-1}	.4825031	0.044505	10.84	0.000
Constant	0.0000821	0.0021071	0.04	0.969
F-test	69.26			
R-squared	0.2677			

Table 4: Results of the two-stage Engle-Granger cointegration test of the spatial model between the import price and the regional producer price

	Jalisco				Coahuila				Veracruz			
Variable	Coef.	SE	t value	P>|t|	Coef.	SE	t value	P>|t|	Coef.	SE	t value	P>|t|
m_{t-1}	-0.0657	0.0169	-3.87	0.000	-.0640	.0169	-3.77	0.000	-.0692	.018	-3.82	0.00
Dm_{t-1}	.1426	0.0510	2.79	0.006	.1366	.0512	2.67	0.008	.0762	.051	1.48	0.13
Constant	-0.0005	0.0024	-0.21	0.831	-.0004	.0021	-0.21	0.832	-.0007	.002	-0.29	0.77
F-test	9.94				9.27				7.66			
R-squared	0.506				0.42				0.39			

SE= standard error.

Like the Engle-Granger test, the Johansen test determines the existence of a stable and long-term equilibrium relationship. The results of the Johansen test of cointegration of the import and domestic producer price series yielded a trace statistical value (5.9169) higher than the critical value of 5 % (3.76), as did the values for the series of prices in Jalisco, Coahuila, and Veracruz (6.8901, 4.7077, 5.0788, respectively); therefore, the null hypothesis of non-cointegration between prices is rejected, i.e., import prices influence the behavior of producer prices at the national level and in the states of Jalisco, Coahuila, and Veracruz in the long term.

Similar studies[14,15] conducted in Mexico with milk price data confirmed the long-term cointegration between the import price and the price paid to the producer, suggesting that the import price influences the behavior of producer milk prices in the long run. In addition to the long-term relationship of Mexican prices with prices in the United States, this relationship with prices in Oceania and the European Union was also verified[15]. This relationship of cointegration of import prices with domestic prices does not always follow a long-term relationship, especially in countries where exports are higher than milk imports[16].

Given the confirmation of cointegration between the import price and the producer price of milk at the national and regional levels, an Error Correction Model (ECM) was estimated, which relates the changes in P_t^{int} with the changes P_t^{farm} in the case of the spatial model and the so-called error correction term (ECT), the lagging residuals of the cointegration equation were calculated.

Spatial vector error correction model: national

The values of ECT_{t-1}^{+} and ECT_{t-1}^{-} reflect that when the import price changes, the producer price at the national level changes in different proportions when it increases compared to when it decreases. When import prices increase, producer prices increase by 8 %, but when import prices decrease, producer prices decrease by 14 % (Table 5).

Table 5: Results of the spatial vector error correction model (VECM) of the import price series and producer price series at the national level

	Symmetric spatial model				Asymmetric spatial model			
Independent variable	**Coef.**	**SE**	**t**	**p>|t|**	**Coef.**	**SE**	**t**	**p>|t|**
$P\text{int}$	0.1140	0.0365	3.12	0.002	---	---	---	
$P\text{int}_t^-$	---	---	---		0.2438	0.1004	2.43	0.016
$P\text{int}_t^+$	---	---	---		0.2493	0.0949	2.63	0.009
$Pfarm_{t-1}$	0.5741	0.0486	11.82	0.000	0.5685	0.0486	11.68	0.000
$Pfarm_{t-2}$	0.1047	0.0503	-2.08	0.038	-0.097	0.0504	-1.94	0.053
$P\text{int}_{t-1}$	0.0105	0.0402	0.26	0.793	0.0149	0.0459	0.33	0.745
$P\text{int}_{t-2}$	-0.0428	0.0376	-1.14	0.255	-0.0385	0.0376	-1.03	0.306
ECT_{t-1}	-0.1135	0.0182	-6.22	0.000	---	---	---	
ECT_{t-1}^+	---	---	---		-0.0861	0.0235	-3.66	0.000
ECT_{t-1}^-	---	---	---		-0.1487	0.0262	-5.66	0.000
Constant	0.00031	0.0019	0.16	0.875	-0.0003	0.0019	-0.16	0.876
Normality: (Prob>z)	0.963				0.96389			
LM test (Prob>Ji^2)	0.863				0.049			
DW test	2.012				1.9148			
R-squared	0.3937				0.3985			
Test: $H_0 : b_1^+ = b_1^-$	---				F(1,374) = 2.35			
Test: $H_0 : b_2^+ = b_2^-$	---				F(1, 372) = 3.41			

SE= standard error.

Similar results are reported in Chile[32] in a study of the spatial transmission of international prices to domestic prices, where negative effects or shocks are passed on more quickly than positive effects, which could be explained by the oligopsonic structure in the reception of fluid milk. As reported in previous studies, for the 1990-2016 period[14], in this study, the contemporaneous exchange coefficients are significantly less than one in both equations, indicating that producer prices do not fully react in one month to changes in international prices. The F-test indicates that the null hypothesis of symmetry $H_0 : b_2^+ = b_2^-$ is accepted at a significance level of 5 % (Prob > F=0.065).

Studies of milk price transmission in Mexico are scarce[14,15] and have yielded different results in error correction models. In the present study, the speed of adjustment of the national price in the event of deviations from equilibrium shows a lower value than in the preliminary studies (-0.113). The evidence of symmetry in the spatial transmission of prices at the national level differs from that found by previous studies in Mexico for the period 1990-2016[14]. This is probably because the period of analysis is different. Nonetheless, the findings of the present research coincide with other recent research in Mexico[15] for the period 2001-2019. On the other hand, in a similar study carried out in Chile[32], they found evidence of asymmetry in the spatial price transmission between markets.

Spatial vector error correction model: regional

The values of the coefficients associated with the ECT of the regional models were negative and significant. The result of the F-test indicates that the null hypothesis of symmetry: $H_o: \beta_2^+ = \beta_2^-$ is accepted at the significance level of 5 % for the response of producer prices in Jalisco (F=1.01) and Veracruz (F=0.02); however, it is rejected for the case of Coahuila (F=7.71; P>F= 0.0058), suggesting evidence of asymmetry in the price response in this state (Table 6). The symmetry results for the transmission of international prices to the producer in Jalisco coincide with what was reported by a recent study carried out in the same region[15], in which they analyzed the transmission of prices from three international markets to the national market, regional market in Jalisco and local market in Chicontepec, Veracruz.

The present study also found differences in the transmission of producer prices from one region to another; the values of ECT_{t-1}^{+} and ECT_{t-1}^{-} reflect that when the import price changes, the producer price in Jalisco, Coahuila, and Veracruz changes in different proportions when it increases compared to when it decreases.

Unlike national and regional (Jalisco) prices, import prices affect prices in the state of Coahuila in different ways; when import prices increase, producer prices in Coahuila increase by 10 %, but when import prices decrease, producer prices decrease by 1 %, i.e., the speed of adjustment is significantly greater when prices rise than when they decrease. The speed of adjustment for producer prices in Veracruz did not show significant differences when prices rise or when they fall (Table 6).

These variations in price transmission and in the response of producer prices in the three regions to changes in import prices may be associated with the market structure within each region. Coahuila is part of La Comarca Lagunera, which together with the state of Durango contribute 22.5 % of the national production[21]; in this region, the specialized system predominates and the market structure is of the oligopsony type; here are the two companies with the largest share in the dairy market in Mexico, LALA and Alpura. Both companies maintain a close relationship with their partners from whom they buy milk at a comparatively high price[33], which could explain why positive changes in import prices are reflected faster than negative changes in producer prices. The importance of the study of market structure as part of the analysis of price transmission in the milk market has already been addressed in other studies[34]. Studies carried out in Mexico[35] and in the milk market between countries that make up a sector at the international level[36] have emphasized the need to consider the analysis of price transmission at the regional level since differences in the response to price transmission between regions can be identified.

Long-term cointegration of the vertical model

For the vertical transmission model between the producer price of milk (P^{prod}) and the retail price (P^{con}), the hypothesis that the retail price is caused by the producer price was tested. Since the time series were non-stationary, was necessary to proceed to perform the long-term cointegration tests using equation (1).

The results of the estimation of equation (1) showed an R^2 of 0.14, a statistical value of t of 16.72, and a statistical value of F of 279.58. The ADF test of the error term showed a test statistic of -3.646, compared to the 5 % critical value of -2.875, indicating that the null hypothesis of non-stationarity is rejected. The results of the two-stage Engle-Granger cointegration test show a negative coefficient of error, confirming the long-term relationship between prices (Table 7).

Table 7: Results of the two-stage Engle-Granger cointegration test for the vertical price transmission model

Variable	Coefficient	Standard error	t-value	P>|t|
η_{t-1}	-0.0963809	0.0155752	-6.19	0.000
$D\eta_{t-1}$	0.5261937	0.0435508	12.08	0.000
Constant	0.000011	0.0021777	0.01	0.996
F-test	81.75			
R-squared	0.3014			

A study of vertical price transmission in the milk market in Russia[37] found that there is no long-term cointegration relationship between producer prices and retail prices; nevertheless, a change in retail price has a significant effect on producer price and vice versa, i.e., there is a bidirectional effect.

The value of the trace statistic (3.3776) of the Johansen test was less than the 5 % critical value (3.76), which does not allow us to reject the null hypothesis of cointegration, i.e., it confirms that the price series are cointegrated.

Vertical vector error correction model

Once the cointegration of retail and producer milk prices was verified, a Vector Error Correction Model[12] was estimated and an F-test was used to test the null hypothesis of symmetry. Error correction models allow to quantify what proportion of the price is transmitted throughout the marketing chain and the speed with which this occurs[12]. The result of the F-test indicates that the null hypothesis of symmetry ($H_o : \beta_2^+ = \beta_2^-$) is accepted at the significance level of 5 % (P>F= 0.5534); this result differs from that found in a previous study in Mexico[14] for the 1990-2016 period, in which they identified evidence of asymmetry in the transmission response of producer prices to the retail market. In contrast to this study, the ECT_{t-1}^- values obtained induce a slightly greater change in the retail price than the ECT_{t-1}^+ (Table 8).

Table 8: Results of the error correction model: symmetrical and asymmetric vertical

	Symmetric model				**Asymmetric model**			
Independent variable	**Coef.**	**SE**	**t**	**p>|t|**	**Coef.**	**SE**	**t**	**p>|t|**
$Pprod_t$	0.0326	0.0593	0.55	0.583	---	---	---	
$Pprod_{t-1}$	0.6234	0.0489	12.75	0.000	0.6248	0.0489	12.75	0.000
$Pprod_{t-2}$	-.1419	0.0511	-2.77	0.006	-0.1441	0.0513	-2.81	0.005
$Pcon_{t-1}$	0.0572	0.0596	0.96	0.338	0.0454	0.0642	0.71	0.480
$Pcon_{t-2}$	-0.0222	0.0592	-0.38	0.708	-0.0222	0.0593	-0.38	0.708
ECT_{t-1}	-0.0780	0.0153	-5.08	0.000	---	---	---	
ECT_{t-1}^+	---	---	---		-0.0692	0.0211	-3.28	0.001
ECT_{t-1}^-	---	---	---		-0.0865	0.0213	-4.06	0.000
Constant	0.0002	0.0020	0.13	0.899	0.00007	0.0020	0.04	0.969
Normality test (Prob>z)	0.99330				0.9933			
LM test (Prob>Ji^2)	1.011				0.996			
DW test	2.013912				2.0144			
R-squared	0.3440				0.3451			
Test: $H_0 : b_2^+ = b_2^-$	---				F (1,372) = 0.35			

SE= standard error.

Studies of the vertical transmission of milk prices in other countries such as Slovakia[38,39], Hungary[40], and Uruguay[30] found evidence of asymmetry in the transmission of prices in different links of the chain. One of the factors causing asymmetry, common in these studies, is the market power of the industry; however, the fact that producers are more integrated into the production chain (being part of the industry through cooperatives, for example) makes them react more quickly to changes in prices[30].

Conclusions and implications

There is a long-term cointegration relationship between import prices of powdered milk and the producer price at the national level and in the regions of Jalisco, Coahuila, and Veracruz, and between retail and domestic producer prices. Import prices of powdered milk are transmitted symmetrically to the producer at the national level and in the regions of Jalisco and Veracruz, indicating that there are no significant differences in the response of the producer price whether import prices increase or decrease. Nevertheless, evidence of asymmetry in the transmission of international prices to producer prices in the state of Coahuila was found, where an increase is transmitted more quickly than a decrease. The speed of adjustment to deviations in long-run equilibrium behaved differently between regions. No evidence of asymmetry was found in the vertical price transmission between the retail price and the domestic producer price; the adjustment speed shows that the response of retail prices is faster when producer prices decrease than when they increase. Understanding the dynamics of the spatial and vertical transmission of prices can guide public policy designers to design more comprehensive and regionally differentiated dairy support programs, thereby ensuring a better distribution of welfare and income throughout the chain. This study contributes to the literature on the transmission of milk prices in Mexico; likewise, it also identifies possible differences in the spatial transmission of milk import prices at the regional level, highlighting the importance for public policy designers to consider regional differences when formulating strategies to serve the sector to ensure a better distribution of welfare and income along the chain. Finally, given the constraints of the model used, it is suggested, in subsequent studies, to extend the linear VECM model to a threshold VECM incorporating the Momentum-Threshold Autoregressive (M-TAR) model since they allow the identification of profound changes in the price series, in addition to the fact that asymmetries in price adjustments can be obtained in the face of positive or negative deviations.

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Table 6: Results of the Regional Asymmetric Spatial Model

	Jalisco				Coahuila				Veracruz			
Independent variable	**Coef.**	**SE**	**t**	**p>|t|**	**Coef.**	**SE**	**t**	**p>|t|**	**Coef.**	**SE**	**t**	**p>|t|**
$P\text{int}_t^-$	-0.0326	0.126	-0.26	0.796	-0.0028	0.105	-0.03	0.978	-0.0258	0.134	-0.19	0.847
$P\text{int}_t^+$	-0.0284	0.119	-0.24	0.796	0.0029	0.099	0.03	0.976	-0.0318	0.126	-0.25	0.801
$Pfarm_{t-1}$	0.1563	0.052	2.99	0.003	0.1086	0.052	2.07	0.039	0.0838	0.053	1.59	0.114
$Pfarm_{t-2}$	-0.0337	0.052	-0.65	0.516	-0.0182	0.051	-0.36	0.723	-0.0029	0.052	-0.06	0.954
$P\text{int}_{t-1}$	0.0648	0.057	1.13	0.259	0.0768	0.047	1.62	0.107	0.0762	0.061	1.25	0.210
$P\text{int}_{t-2}$	-0.0220	0.046	-0.48	0.631	-0.0158	0.038	-0.42	0.678	-0.0470	0.048	-0.97	0.334
ECT_{t-1}^+	-0.0497	0.023	-2.14	0.033	-0.1037	0.022	-4.70	0.000	-0.0737	0.024	-3.10	0.002
ECT_{t-1}^-	-0.0847	0.027	-3.17	0.002	-0.0105	0.025	-0.42	0.674	-0.0690	0.028	-2.47	0.014
Constant	-0.0008	0.002	-0.33	0.743	-0.0008	0.002	0.39	0.697	-0.0004	0.003	-0.17	0.867
Normality test (Prob>z)	0.8032				0.8554				0.7778			
LM test (Prob>Ji^2)	1.546				1.706				0.303			
DW test	1.511				1.668				0.296			
R-squared	0.637				0.855				0.550			
Test: $H_0: b_2^+ = b_2^-$	F(1, 366) = 1.01				F(1, 366) = 7.71				F(1, 366) = 0.02			

SE= standard error.

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