

The dynamics of the pork-market structure in the State of Mexico, 2017-2021

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ABSTRACT

Objective: Identify the main entities of origin and/or destination in the transfer flows of live pigs across slaughterhouses, fattening farms, breeding facilities, and fair markets in the State of Mexico. Additionally, detect potential information asymmetries to design public policy strategies that enhance efficiency and equity in pig mobilization.

Design/methodology/approach: This study employs the Social Network Analysis (SNA) approach, analyzing data from 2017 to 2021 across four market types (*i.e.*, slaughter, fattening, breeding, and fairs). The study identifies 24 source entities and 29 destination entities, some of which function as both origins and destinations.

Results: Pig mobilization in the State of Mexico reveals a network of interactions among different market types, influenced by geographical, productive, and economic factors, as well as consumer preferences. The network exhibits significant centralization in certain markets, particularly slaughterhouses, where Puebla, Jalisco, and Veracruz emerge as the main contributors to pig livestock mobilization. Challenges related to reciprocity in trade relationships suggest imbalances in the distribution of pork commerce within the State of Mexico.

Limitations/implications: The lack of participation by some states in government-sponsored fairs, coupled with restrictive pig-breeding regulations in certain regions, highlights the need for targeted strategies to address the challenges within each market type.

Findings/conclusions: Public policies should foster transparency, competition, and equitable access to resources and markets. Additionally, addressing information asymmetries is crucial to ensuring food security and promoting animal welfare in the pork industry of the State of Mexico.

Keywords: Network analysis, pork industry structure, market connectivity, distribution networks.

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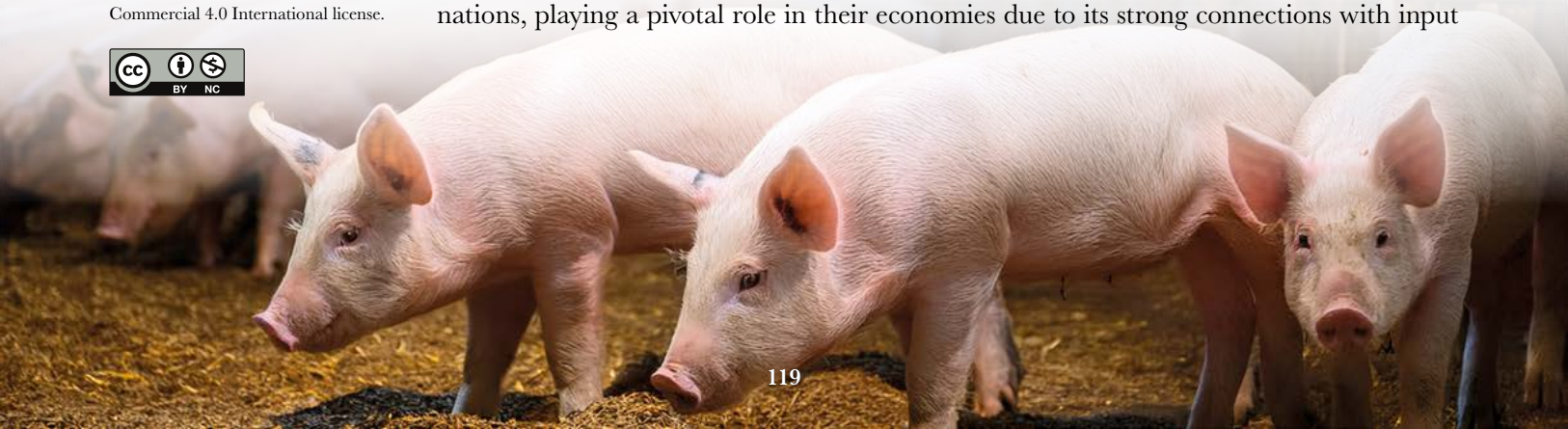
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INTRODUCTION

Pig farming is intrinsically linked to the agri-food and agro-industrial production of nations, playing a pivotal role in their economies due to its strong connections with input



supply chains and processing industries (Sosa *et al.*, 2017; Iglesias *et al.*, 2017; Peña, 2011). In Mexico, it stands as one of the most dynamic livestock-related activities, distinguished by its significant multiplier effect, with a product factor of 3.40 (Sosa *et al.*, 2017). It is regarded as a key driver of economic growth, given its extensive ripple effect across multiple industrial sectors. Mexico ranks among Latin America's leading producers and consumers of pork. In 2021 alone, the country produced 1,693,007 tons, with the primary pork-producing states being Jalisco (22% of total production), Sonora (18%), Puebla (11%), Yucatán (9%), and Veracruz (9%), collectively accounting for 69% of the nation's total output (SIAP, 2022a). From a zootechnical perspective, this production is categorized into six segments: 'breeding stock' (106,068), 'cull pigs' (188,835), 'replacement pigs' (228,683), 'sows' (1,246,276), 'piglets' (3,987,715), and 'fattening pigs' (10,263,741) (INEGI, 2022). The main distribution destinations were the State of Mexico (with a quarterly expenditure of MXP 1,950 million), Mexico City (MXP 924 million), Veracruz (MXP 870 million), Puebla (MXP 859 million), and Jalisco (MXP 747 million), driven by factors such as population density, purchasing power, and production capacity. With a population of 16.9 million inhabitants, the State of Mexico plays a crucial role in pork production and consumption. In 2021, it ranked as the 12th most significant pork-producing state, with an average pig weight of 74.86 kg per head and a market price of MXP 50.70 per kg of pork (SIAP, 2022b). However, while these figures reflect the final consumer stage of the cold carcass market, they fail to account for the primary production stage, the origins and destinations of live pigs, or the specific type of market (*i.e.*, slaughter, fattening, breeding, or fairs) toward which the supply and demand are directed (Callejas *et al.*, 2020). Given this context, pig trade and mobilization across various regions and market types constitute a fundamental component of the value chain. Consequently, this study proposes analyzing the pig-farming system in the State of Mexico as a network structure, enabling small producers to strategically plan, enhance productivity, and access regional markets (Gelabert *et al.*, 2017). Moreover, such an approach fosters the development of innovative ecological management systems for agricultural lands (Staver *et al.*, 2004), strengthens mechanisms for disease detection and control, and facilitates a deeper understanding of the social complexity underlying interactions among pig farmers and other key stakeholders in the information-exchange process (Andico *et al.*, 2021). These measures, in turn, would enable the formulation of public policy strategies aimed at optimizing pig mobilization from source to destination, thereby mitigating delays, streamlining logistics, reducing costs, and ensuring stringent monitoring to prevent disease transmission along the production chain. Given the imperative to further develop the pork industry in the State of Mexico, this research aims to analyze the mobilization of live pigs by market type (slaughter, fattening, breeding, and fairs), identifying key actors, intermediation hubs, and information asymmetries. This will be achieved using Social Network Analysis (SNA) to evaluate transfer flows and network centralization. This methodological approach will facilitate the identification of hierarchies and roles within the pork market, shedding light on the influence of information asymmetry and guiding the design of public policies to enhance transparency and efficiency within the sector.

MATERIALS AND METHODS

The study examined the interstate pig-mobilization system in the State of Mexico, which comprises 125 municipalities, a population of 16.9 million inhabitants (representing 13.5% of Mexico's total population), and holds significant importance in the country's agriculture and livestock sector (INEGI, 2020). The data were obtained from the daily records database for the period 2017-2021, with the explicit authorization of SENASICA, considering the available information from the states that supply pigs to the State of Mexico and receive them from this entity for slaughter, fattening, breeding, and fairs. The analysis encompassed 24 source entities (xi) and 29 destination entities (xj).

Data analysis: Social-network analysis (SNA)

Social Network Analysis (SNA) was employed to examine topological trends in the pork market and identify social hierarchies and roles within the analyzed structure. The study utilized UCINET (version 6.27) and VISONE (version 2.2) software for network visualization and analysis. To determine social density, mathematical centrality and clustering equations were applied (Velázquez *et al.*, 2005; Núñez *et al.*, 2022), while degree centrality was assessed following the definition of Proctor and Loomis (1951). The total number of heads per source-node and destination-node was calculated using in-degree data (Wasserman *et al.*, 2013) and out-degree data (Pérez, 2021). Furthermore, each source and destination state's influence and power were analyzed within the mobilization-network structure, following the asymmetric-information theory. Information asymmetry arises when market entities do not have equal access to information, leading to market failures (Ayat *et al.*, 2020). Since such asymmetry allows for an in-depth examination of how unequal access to information affects decision-making and economic outcomes across different sociopolitical and economic contexts, its implications were assessed through various dimensions, including competition promotion, supply-chain diversification, transparency in business transactions, information-system development, access to communication technologies, direct market-initiative subsidies, regulatory oversight, and livestock traceability and quality control. The degree of information asymmetry was quantified using mathematical equations to determine network intermediation (Freeman, 1977) and cliques (Brandes, 2005; Núñez-Espinoza *et al.*, 2022).

RESULTS AND DISCUSSION

The State of Mexico maintains a negative trade balance in the pig market across all categories: slaughter, fattening, breeding, and fairs. The analysis revealed that while 48.56 million heads were mobilized into the State of Mexico, only 122,636 heads were mobilized out. A significant 91.7% of incoming shipments originated from Puebla (31.2%), Jalisco (25.8%), Veracruz (21.4%), and Guanajuato (10.1%), while the primary destination states were Hidalgo (23.85%), Tlaxcala (5.77%), and Puebla (4.09%). The distribution by market type showed that 99.4% of pigs mobilized to the State of Mexico were intended for slaughter, followed by those for the fattening market (0.57%), breeding (0.04%), and fairs (less than 0.01%). Regarding the origins of pig shipments by purpose, the pigs destined for slaughter primarily came from Puebla (34.31%), Jalisco (25.88%), and Veracruz (21.48%),

while those intended for fattening originated mainly from Puebla (17.89%), Morelos (17.19%), and Jalisco (16.44%). In terms of breeding, the largest contributions were from Jalisco (40.65%), Zacatecas (7.89%), and Guanajuato (6.83%), whereas the pigs destined for fairs predominantly came from Jalisco (64.33%), Guanajuato (23.94%), and Sonora (11.70%). On the other hand, the mobilization of pigs from the State of Mexico to other states followed a distinct pattern. The majority of shipments for slaughter were directed to Hidalgo (30.08%), Querétaro (5.99%), and Guerrero (2.75%), while those for fattening were sent to Tlaxcala (14.93%), Hidalgo (13.30%), and Puebla (6.50%). The breeding market primarily received pigs in Morelos (8.68%), Hidalgo (18.31%), and Chiapas (9.39%), whereas the vast majority of pigs mobilized for fairs were destined for Mexico City (99.47%) and Baja California Sur (0.53%). In total, 264,273 pig mobilizations were recorded into the State of Mexico, with 33.6% originating from Puebla, 26.6% from Jalisco, 20.7% from Veracruz, and the remainder from other states. Additionally, 42.9% of all pig mobilizations within the State of Mexico were intrastate, while 21.0% were destined for Hidalgo, with the rest distributed across 28 other states with which the State of Mexico maintains trade links (Figure 1). These data underscore the complexity and

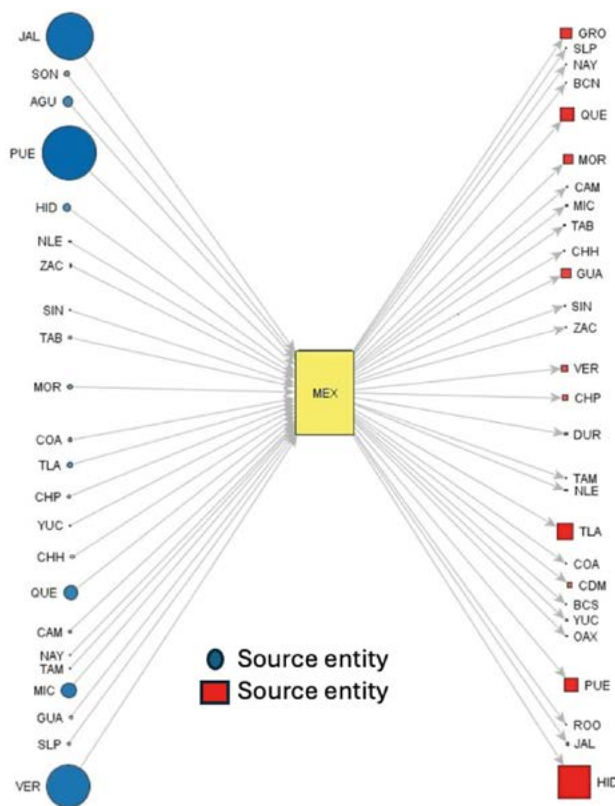


Figure 1. Pork-market dynamics in the State of Mexico by type of mobilization, 2017-2021. BCN=Baja California Norte; BCS=BAJA California Sur; CDM=Mexico City; COL=Colima; DUR=Durango; GRO=Guerrero; ROO=Quintana Roo; YUC=Yucatán; CAM=Campeche; CHP=Chiapas; NAY=Nayarit; OAX=Oaxaca; TAB=Tabasco; CHH=Chihuahua; PUEB=Puebla; MIC=Michoacán; VER=Veracruz; SIN=Sinaloa; SON=Sonora; MEX=State of Mexico; ZAC=Zacatecas; GUA=Guanajuato; JAL=Jalisco; SLP=San Luis Potosi; AGU=Aguascalientes; TLA=Tlaxcala; QUE=Querétaro; NLE=Nuevo León; COA=Coahuila; MOR=Morelos; TAM=Tampico; HID=Hidalgo.

concentration of the pig trade network, revealing both strong regional dependencies and market asymmetries in the mobilization dynamics of the sector.

In addition to the shortage of pigs, the decline in pig transfers between 2019 and 2021 is closely linked to a global disruption in the supply chain of agri-food products (Kerr, 2020). One of the most significant factors was the impact of African Swine Fever (ASF) on the pork industry worldwide, which may have begun to affect pig mobilization in Mexico as early as 2019. However, the most pronounced decrease occurred in 2020, coinciding with the onset of the COVID-19 pandemic, which severely disrupted supply chains, hindered transportation and processing, and led to temporary market closures. The pandemic's effects persisted into 2021, with residual restrictions and a gradual recovery in the livestock sector continuing to influence the transfer of live pigs (Table 1).

However, the State of Mexico exhibited a deficit in the supply of pigs for slaughter, fattening, reproduction, and fairs, which complicated its commercial interactions with other states. Between 2017 and 2021, the main pig-supplying states to the State of Mexico were Puebla, Jalisco, Veracruz, and Guanajuato. Puebla, located approximately 130 km east of the capital of the State of Mexico, stood out as the largest supplier, accounting for 31.2% of the pigs mobilized. Jalisco, situated about 350 km to the west, contributed 25.8%, while Veracruz, approximately 450 km to the east, supplied 21.4%, and Guanajuato, around 300 km to the northwest, accounted for 10.1% of the total supply. In terms of demand, the State of Mexico maintained significant trade interactions with other entities, particularly Hidalgo, Tlaxcala, and Puebla. Hidalgo, located 250 km to the north, was one of the primary destinations, receiving 23.85% of pigs mobilized from the State of Mexico. Tlaxcala, about 200 km to the east, and Puebla, 130 km away, were also key recipients of pig livestock from this region. Mobilization data from 2017 to 2021 revealed a centralized distribution network, with a few states functioning as major nodes in pig mobilization. This centralization resulted in a star-shaped structure, where states such as Puebla and Jalisco held dominant positions due to their high concentration of connections. The asymmetry of information between origin and destination states can significantly impact market efficiency and equity. Public policies must address these imbalances, ensuring greater transparency in transactions. According to Callejas *et al.* (2020), it is crucial to analyze the first link in the supply chain—the producer—alongside the origin, destination, and type of market (slaughter, fattening, reproduction, or fairs) to which the supply and demand of pigs are directed. However, previous research has primarily focused on the cold-channel final

Table 1. Pig movement by market type in State of Mexico (2017-2021).

Year	Slaughter	Fattening	Breeding	Fairs	Total (year)
2017	10,700,053	55,526	1,875	36	10,757,490
2018	10,624,564	75,426	3,397	129	10,703,516
2019	10,062,205	38,760	2,653	0	10,103,618
2020	8,685,878	45,182	1,608	6	8,732,674
2021	8,282,506	45,882	2,428	0	8,330,816
Total (market)	48,355,206	260,776	11,961	171	48,628,114

Source: Own elaboration with SENASICA (2017-2021).

consumer value chain, often overlooking these critical aspects. The overconcentration of power in the hands of a few key actors can exacerbate information asymmetry, limit choices for producers and consumers, and create an imbalanced competitive landscape. Public policies should promote competition in the pork market, encourage the entry of new players, and diversify both distribution and sales channels. A highly concentrated market structure can generate distorted price signals, ultimately influencing producers' economic and financial decision-making in future market conditions (Martínez-Castañeda *et al.*, 2024).

Interstate network of pig mobilizations for purposes of slaughter

The State of Mexico's trail network exhibited a network centralization of 3.7% for outbound links and 11.8% for inbound links (Figure 2A). The distribution of pig mobilization was found to be highly polarized, as a small number of entities maintained a disproportionately high number of connections. This pattern reflects a star-shaped network structure, in which certain states function as major hubs, concentrating trade flows and influencing market dynamics. Several source entities, such as Mexico City, Guerrero, and Oaxaca, as well as peripheral destination entities, including Coahuila, Nayarit, Nuevo León, Sinaloa, Sonora, Tamaulipas, Yucatán, and Zacatecas, were identified as being at a disadvantage in terms of negotiating power and access to information. This asymmetry in market participation underscores the need for public policies that enhance transparency in the pig-farming sector. Ensuring clarity in business contracts and agreements is essential to leveling the playing field, allowing both producer and consumer states to access comprehensive and reliable information regarding transaction terms and market prices.

Interstate network of pig mobilizations for purposes of fattening

We recorded 1,327 entry mobilizations, with the State of Puebla leading in connectivity, registering 265 connections, followed by Morelos with 206 connections and Michoacán with 197 connections. Conversely, as a source state, the State of Mexico maintained only 182 business links, with its primary purchasers being Hidalgo (45 links) and Tlaxcala (44 links). The mean number of entry and exit connections was 79.42, with the State of Mexico and Puebla emerging as the most highly connected states, highlighting their strategic importance within the network. Network centralization was 4.10% for exit links and 60% for entry links, indicating a decentralized trading structure for source states, whereas destination-state trading relationships were more centralized, with the State of Mexico serving as the central node in the network (Figure 2B). According to Santos-Barrios *et al.* (2021), despite the State of Mexico's strong involvement in pig farming, the number of pigs purchased for fattening exceeds those sold, creating information asymmetry for farmers and fostering a prevalence of informal production, particularly in rural areas and small-scale operations. Additionally, pig farmers face competitive disadvantages, as many are unfamiliar with the registration and compliance requirements established by SENASICA. The lack of access to reliable information, geographic challenges in reaching pig-farming zones, limited technical support, and financial constraints further hinder compliance with official regulations. Consequently, inspection and certification services remain scarce,

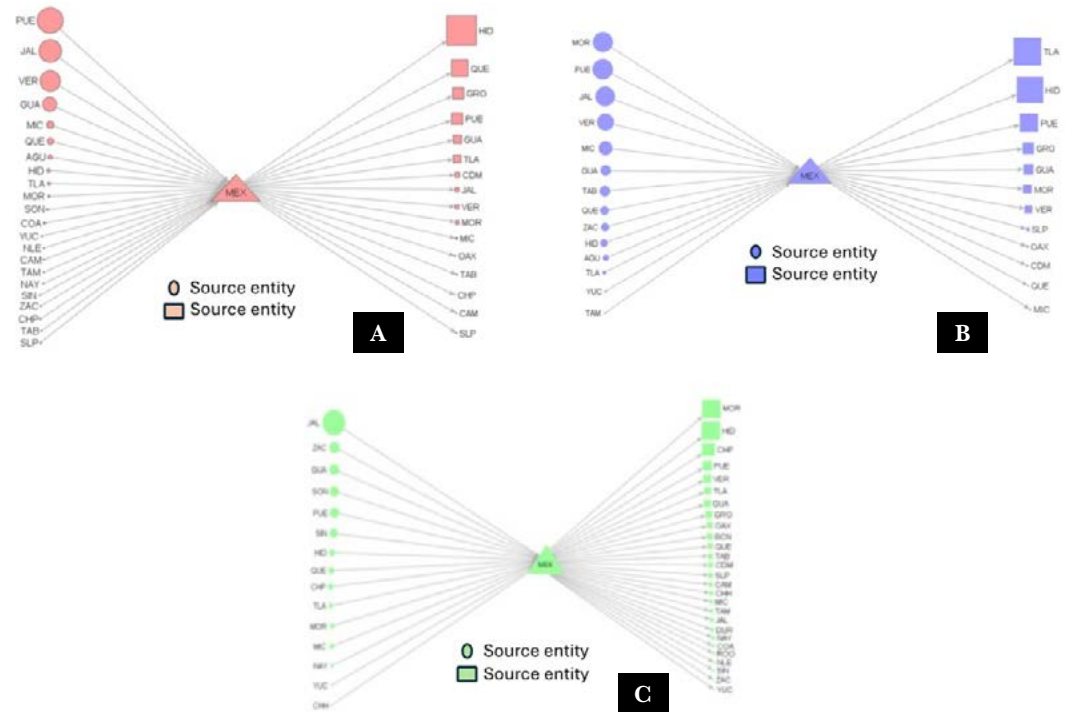


Figure 2. Pig-mobilization dynamics in the State of Mexico, 2017-2021.

A=slaughter; B=fattening; C=breeding.

BCN=Baja California Norte; BCS=BAJA California Sur; CDM=Mexico City; COL=Colima; DUR=Durango; GRO=Guerrero; ROO=Quintana Roo; YUC=Yucatán; CAM=Campeche; CHP=Chiapas; NAY=Nayarit; OAX=Oaxaca; TAB=Tabasco; CHH=Chihuahua; PUEB=Puebla; MIC=Michoacán; VER=Veracruz; SIN=Sinaloa; SON=Sonora; MEX=State of Mexico; ZAC=Zacatecas; GUA=Guanajuato; JAL=Jalisco; SLP=San Luis Potosi; AGU=Aguascalientes; TLA=Tlaxcala; QUE=Querétaro; NLE=Nuevo León; COA=Coahuila; MOR=Morelos; TAM=Tampico; HID=Hidalgo.

exacerbated by the perception that the pig-farming sector does not receive sufficient tangible benefits or incentives (Cuevas *et al.*, 2012).

Interstate network of pig mobilizations for purposes of breeding

The mean number of entry and exit trading connections in the State of Mexico was 41, with a total of 1,189 trading relationships, indicating a relatively balanced distribution within the network. The minimum and maximum numbers of relationships between source states were 0 and 563, respectively, while the minimum and maximum numbers of relationships between destination states were 0 and 626, respectively.

These results indicate that the degree of centralization of exit trading relationships was 7.02%, reflecting a moderate concentration within the network, while the degree of centralization of entrance trading relationships was similar, at 7.86%. The breeding-market network exhibited the highest number of trading relationships, with the State of Mexico participating in 563 trading relationships as a source state and 626 as a destination state. Jalisco also played a significant role, showing a strong source-state trend with 275 exit relationships, but a limited number of only 9 entrance connections. Meanwhile, Hidalgo had just 9 exit connections, yet was an active receiver of mobilizations, with 116 trading

relationships. Similarly, Morelos emerged as a major destination state, registering 65 destination relationships and only 5 source connections (Figure 2C). These findings are highly relevant, as they pertain to the commercial exchange of breeding stock and future breeders, which will eventually supply pork to the regions where this genetic material is distributed. In contrast, Mexico City and Veracruz, despite being geographically close, did not record any business transactions as source entities. However, both functioned as destination entities, with Mexico City registering 26 trading relationships and Veracruz 55. In the case of Mexico City, public policies discourage pig breeding due to its high population density, where municipal regulations either restrict or prohibit livestock production to mitigate issues related to noise, odors, public health, and animal welfare. Indeed, public-health and food-security policies should impose strict regulatory requirements on pig farming to ensure that pork products meet safety standards. Such regulations may include hygiene protocols, waste management systems, disease control measures, and sustainable production practices, which can be difficult to implement in an urban environment like Mexico City (Losada *et al.*, 1982; Rivera *et al.*, 2007). Similarly, in Veracruz, public policies also discourage pig breeding, though for environmental, sanitary, and economic reasons, as well as competition with other livestock industries and concerns related to tourism. Veracruz, characterized by significant environmental and ecological diversity, has policies designed to protect natural resources and fragile ecosystems. Consequently, environmental regulations may impose restrictions on pig farming to prevent water contamination, deforestation, and other ecological impacts associated with intensive production systems. Furthermore, Veracruz's economic and agricultural landscape prioritizes certain livestock activities over others for financial, environmental, and social considerations. The state is widely recognized for its diverse production systems, which include cattle and poultry farming, among others. Additionally, competition for essential resources, such as land, water, and feed, may influence producers to favor alternative livestock species over pig breeding. Lastly, Veracruz's status as a financial hub and a major tourist destination likely contributes to policy restrictions on activities that could negatively impact the environment and the region's appeal to visitors. Given the potential environmental and public-health concerns associated with intensive pig farming, this activity may not align with the broader public-policy objectives of the state (Gutiérrez *et al.*, 2015).

Interstate network of pig mobilizations for purposes of fairs

The only available records for fairs pertain to events authorized and organized by government institutions. The average number of business relationships in this market was four per source state and destination state, with a total of 24 entry and exit links within the six-state network. Guanajuato was the most active source state, with 16 business relationships, yet it lacked entry connections, functioning primarily as a remitter rather than a receiver within the network. Meanwhile, the State of Mexico was the main destination entity, holding 18 entry business links, positioning itself as a central node in the fair-market network and establishing entry and exit links with other states involved in pig mobilization. The limited participation of State of Mexico producers in government-sponsored fairs is largely attributed to the fact that most are small-scale farmers who perceive the registration

process as overly bureaucratic and feel that they lack the necessary documentation to take part in such events. Some fairs require sanitary certification to verify that animals are free from contagious diseases and compliant with animal health regulations. Additional requirements may include vaccination records, veterinary treatment documentation, and official identification methods such as tags, microchips, or identification numbers. Moreover, certain fairs mandate enrollment fees or payments to cover event organization costs, while participants must ensure that their pigs meet optimal exhibition standards. Some events also require third-party liability insurance to cover any contingencies, along with strict registration deadlines and compliance with organizer-imposed conditions (SENASICA, 2017). Given these barriers, pork producers in the State of Mexico remain underrepresented, placing them at a competitive disadvantage compared to other states in the design and implementation of public policies. Consequently, their needs and interests are often overlooked when organizing fairs that facilitate commercial interactions. According to Rebollar *et al.* (2016), economic growth in the midwestern region, which includes the State of Mexico, has been slow due to a lack of support policies, inefficient resource utilization, and low productivity levels. Therefore, state-level public policies should integrate targeted strategies to mitigate information asymmetry between pig-producing states, government institutions, and pig-purchasing entities. These structural deficiencies lead to inadequate, outdated, inefficient, or overly restrictive regulations, hindering state participation in fairs and failing to support the development of the pork industry. Bureaucratic hurdles, limited access to resources and financial aid programs, and inadequate infrastructure—such as exhibition facilities, animal transportation means, and logistical support—further restrict the effectiveness and reach of these events (Puente, 2013).

Additionally, pig fairs pose a biosecurity risk, as they can facilitate the spread of animal diseases unless proper preventive policies are in place. Public policies regarding the market should also address broader concerns, including environmental and social sustainability, waste management, responsible resource usage, and labor rights within the pork industry. Despite its potential as a strategic platform for the State of Mexico to showcase and market its pigs to other states, the absence of comprehensive market-development policies and structured growth strategies significantly limits its economic impact and income-generation potential.

Key factors of the mobilization of live pigs in the State of Mexico

The mobilization of pigs in the State of Mexico revealed a network shaped by multiple factors that influence the dynamics of live animal transfers. The debate over whether these mobilizations are primarily driven by geographical proximity, economic factors, or consumer preferences must take into account several interrelated aspects. Geographic proximity plays a crucial role in pig mobilization, as evidenced by the fact that states closest to the State of Mexico, such as Puebla (130 km away) and Morelos (approximately 100 km away), are the main suppliers of pigs for slaughterhouses and fattening, respectively. The reduction in transportation costs and the mitigation of risks associated with long-distance movement, such as mortality and stress in animals, provide a competitive advantage to nearby states. This proximity enhances logistical efficiency, reduces operating costs, and

optimizes the delivery process, making short-distance suppliers more competitive in the market. Beyond geographic factors, the economic and productive capacity of each state significantly influences pig mobilization dynamics. For example, Jalisco, which accounts for 22% of national production, and Puebla, which contributes 11%, possess highly developed livestock infrastructure and substantial production capacity. This allows them to not only supply large volumes of pigs but also compete in broader markets, including the State of Mexico. Their financial strength and investment in livestock infrastructure enable them to offer competitive prices and secure long-term supply contracts, particularly with the State of Mexico, which, despite being a major consumer, faces a local production deficit. Consequently, it must rely on external suppliers to meet demand, reinforcing the importance of supplier states with strong production capacity that can absorb additional costs and market fluctuations.

Consumer preferences also play a role in pig mobilization, as residents of the State of Mexico may have specific preferences regarding meat type, quality, and origin, influencing supplier selection. However, given that 99.4% of pigs mobilized to the State of Mexico are destined for slaughter, consumer preferences likely hold less weight compared to the overriding need to meet processing and distribution demands. Additionally, a lack of information regarding pig prices, quality, and availability can result in inefficient decision-making and an overreliance on specific supplier states. To address this information asymmetry, public policies should promote transparency, enhance access to market data, and introduce incentives for a more balanced distribution of production and supply.

CONCLUSIONS

The State of Mexico maintains a negative trade balance across all four pig markets slaughter, fattening, breeding, and fairs with a high degree of centralization in the slaughter market, which has significant implications for competition and access to information.

The mobilization of pigs in the State of Mexico is shaped by a combination of geographic proximity, economic conditions, and, to a lesser extent, consumer preferences. Proximity plays a crucial role by reducing transportation costs and risks, while the economic capacity of supplier states ensures a reliable and competitive supply chain. However, several challenges persist, particularly the lack of reciprocity in certain trading relationships between the State of Mexico and other federal entities. The asymmetry in the number of mobilized pigs highlights the urgent need for public policies that promote the timely generation of and access to comprehensive information across the entire value chain.

The information asymmetry theory underscores the importance of ensuring equitable access to market information within the pig farming sector of the State of Mexico. Addressing information gaps is essential to ensuring food security, protecting public health, and fostering animal welfare. In this regard, public policies play a crucial role by enhancing transparency in the supply chain, establishing clear and effective regulations, and implementing robust oversight mechanisms. These policies should ensure that producer states comply with quality and animal-welfare standards through incentives that encourage good practices and sanctions for regulatory non-compliance, thereby aligning the interests of producer states within the pig markets. Moreover, continuous

training and education on best production practices, animal management, and animal health are fundamental to improving pork production quality and sustainability. The findings of this study emphasize the necessity of conducting targeted research on the four pork-production systems, thereby mitigating risks to the long-term sustainability of this vital protein source in the State of Mexico.

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