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## Vertical coordination in the pig sector: InterPIG and agri benchmark overview

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**Abstract** – This study aims to present a qualitative overview of vertical coordination in global pork production, based on the literature on supply chain governance, according to which vertical coordination can be understood as a governance continuum ranging from spot market transactions to full vertical integration. A qualitative survey was conducted in 2024 among 24 participants from 21 countries, members of two global pig expert networks, InterPIG and agri benchmark Pig, using an electronic questionnaire comprising 20 multiple-choice and open-ended questions. Five categories of vertical coordination forms (spot market, marketing contracts, production contracts, cooperative contracts, and vertical integration) and six categories of market shares were used to present a qualitative graphical representation of vertical coordination across countries, to calculate a vertical coordination indicator and a vertical coordination fragmentation index, and to group countries. Four levels of influence and 10 categories of decision dimensions were used to present a qualitative graphical representation of the usual pig producer role, while expected trends and other characteristics were described graphically or textually. The results indicate that spot markets and marketing and production contracts are the most common forms of vertical coordination, followed by cooperative contracts and vertical integration (full ownership). Almost all countries were classified according to their dominant form of vertical coordination, except for some with a "mixed" organization, where no specific form predominates. However, forms of vertical coordination are not mutually exclusive and can occur simultaneously in the same region or even in the same company or cooperative, with combined models. In general, experts expect over the next ten years an increase in contracts and vertical integration at the expense of the spot market, together with the relative stability in cooperative contracts. Finally, coordination can be achieved in many ways, may be defined differently across countries, and may also take horizontal forms.

**Index terms:** governance, hybrid forms, spot market, vertical integration, pig farming.

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## **Coordenação vertical na suinocultura: panorama das redes InterPIG e agri benchmark**

**Resumo** – Este estudo tem como objetivo apresentar uma visão qualitativa da coordenação vertical na produção global de carne suína, com base na literatura sobre governança das cadeias produtivas, segundo a qual a coordenação vertical pode ser entendida como um espectro de formas de governança com as transações no mercado à vista (*spot*) em um extremo, e a integração vertical plena no outro. Uma pesquisa qualitativa foi realizada em 2024 com 24 participantes de 21 países, membros de duas redes globais de especialistas em suinocultura, InterPIG e agri benchmark Pig, utilizando um questionário eletrônico composto por 20 questões de múltipla escolha e questões abertas. Cinco categorias de formas de coordenação vertical (mercado *spot*, contratos de comercialização, contratos de produção, contratos cooperativos e integração vertical) e seis categorias de participação de mercado foram utilizadas para apresentar uma representação gráfica qualitativa da coordenação vertical entre os países, para calcular um indicador de coordenação vertical e um índice de fragmentação da coordenação vertical, e para agrupar os países. Quatro níveis de influência e 10 categorias de dimensões de decisão foram utilizados para apresentar uma representação gráfica qualitativa do papel usual dos suinocultores, enquanto as tendências esperadas e outras características foram descritas gráfica e textualmente. Os resultados indicam que o mercado à vista (*spot*) e os contratos de comercialização e de produção são as formas mais comuns de coordenação vertical, seguidos pelos contratos cooperativos e pela integração vertical (propriedade plena). Quase todos os países foram classificados de acordo com sua forma dominante de coordenação vertical, exceto alguns com uma organização "mista", onde nenhuma forma específica predomina. No entanto, as formas de coordenação vertical não são mutuamente exclusivas e podem ocorrer simultaneamente na mesma região ou mesmo na mesma empresa ou cooperativa, com modelos combinados. Em geral, os especialistas esperam, nos próximos dez anos, um aumento nos contratos e na integração vertical em detrimento do mercado à vista (*spot*), juntamente com a relativa estabilidade dos contratos cooperativos. Por fim, a coordenação pode ser alcançada de muitas maneiras, pode ser definida de forma diferente entre os países e também pode assumir formas horizontais.

**Termos de indexação:** governança, formas híbridas, mercado à vista, integração vertical, suinocultura.

## **Introduction**

Pork is the second most important meat consumed in the world, with a gross value of \$355 billion Dollars, equivalent to 7% of the value of global food production. Pig farming is concentrated in China, with almost half of world production, followed by the European Union (EU) and the United States (US), then Brazil, Russia, Vietnam and Canada (FAO, 2024). There is a great diversity of supply chain models among countries and also within them, involving different farm and industrial structures, institutions and forms of coordination (Key; McBride, 2007; Trienekens et al., 2009; Janssens et al., 2012; Zhuo et al., 2021; Martins et al., 2017; Parcell et al., 2024). In this way, pig producers' relationships with upstream and downstream stages of the supply chain are key dimensions for understanding the organization and performance of the pig meat industry (Martinez; Zering, 2004; Schulze-Ehlers et al., 2007; Martins et al., 2022; Zhuo et al., 2021).

This study aims to present a qualitative overview of vertical coordination in global pork production, mainly from the pig farmers' perspective, focusing on the most representative coordination forms across 21 countries in Europe (15), Americas (3), Asia (2), and Africa (1). Together, these countries account for 82% of global pork production and 94% of exports (FAO, 2024). The analysis is based on the literature on supply chain governance (Barkema; Drabentstott, 1995; Zuurbier, 1996; Zylbersztajn; Farina, 1999; Menard; Klein, 2004; Zylbersztajn, 2016), and follows up on two previous studies on coordination in the pig sector conducted at different times by InterPIG and agri benchmark Pig networks members (Hoste, 2017a, 2017b; Potori, 2018)<sup>1</sup>.

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<sup>1</sup> InterPIG is an independent forum of pig production economists (<http://interpig.org/#>) and agri benchmark Pig is a global, non-profit network of agricultural economists, advisors, producers and specialists in the pork value chain (<https://agribenchmark.org/pig/>). These networks aim to compare costs of professional pig production and also exchange information.

## Methodology

Vertical coordination refers to the way legally independent firms align and govern their activities along the supply chain, for example through market transactions, contracts, cooperative, or ownership arrangements. Integration represents a specific, high-control form of vertical coordination, in which a single firm owns and manages multiple adjacent stages of the supply chain, from input provision to processing or retailing, thereby exercising full control over production and product flows. Vertical coordination can be understood as a governance continuum ranging from spot market transactions at one extreme to full vertical integration at the other (Zuurbiër, 1996).

A qualitative survey was conducted among members of two global pig economics expert networks, InterPIG and agri benchmark Pig. An electronic questionnaire was used, comprising 11 multiple-choice questions and five open-ended questions, in addition to four identification questions. It was completed by participants between May and July 2024, followed by the presentation and analysis of the results at the InterPIG and agri benchmark Pig annual meetings in 2024 and 2025. The survey reflects the views of 24 experts from 21 countries<sup>2</sup> who are members of these networks (InterPIG, 2024; Agri benchmark, 2025).

The definitions used in this study were adapted from MacDonald et al. (2004) as follows:

- **Spot market (independent players):** the pig farmer controls production assets and decisions and receives a price for piglets or slaughter pigs that is negotiated at the time of sale, just prior to delivery. In this context, tacit agreements may occur, implying a greater degree of coordination than pure spot transactions. These are defined as customary trade partnerships without formal contracts (also referred to as historical partnerships or verbal contracts in some countries).
- **Marketing contract:** the farmer controls production assets and decisions and receives a price for piglets or slaughter pigs that is negotiated before or during the production period. Contracts may specify output characteristics, quality standards, quantities, and delivery timing.

- **Production contracts:** the contractor exercises control over some production assets and key production decisions. Contracts typically specify weights, quality standards, quantities and delivery timing. The farmer is paid by a company a fee for services rendered in the production of piglets or slaughter pigs.
- **Cooperative contracts:** this mainly differs from marketing and production contracts with private companies in that farmers are members of a cooperative and collectively decide on its strategic direction (typically one member = one vote). Marketing and production contracts may occur and often have similar characteristics to contracts with private companies.
- **Vertical integration (full ownership):** a single company owns and controls production assets and decisions at stages adjacent to pig farming (upstream and/or downstream). Product transfers occur through internal managerial decisions rather than market transactions, and the farm operator-manager typically holds employee status and is compensated similarly to other employees of the company.

Considering the qualitative and exploratory approach of the study, and its broad geographic scope, the questionnaire considered those categories as mutually exclusive, in order to keep it simple. However, authors acknowledge that forms of vertical coordination are not mutually exclusive and can occur simultaneously in the same region or in the same supply chain, with combined models (Zhuo et al., 2021).

Market shares for each type of vertical coordination considered six categories (“≥ 75%”; “≥ 50% and < 75%”; “≥ 25% and < 50%”; “< 25%”; “Not relevant” and “I don’t know”). For the qualitative graphical representation in Figure 1, the following percentage values were assigned: 87.5% (average of 75% and 100%); 62.5% (average of 50% and 75%); 37.5% (average of 25% and 50%); 12.5% (average of 0% and 25%); and 0% when the category was “not relevant”. The percentages for each category were adjusted to total 100% when the sum exceeded or fell below that value. Countries were ordered from highest to lowest market share in the spot market category, followed by marketing contracts, production contracts and finally cooperative contracts.

This ordering does not necessarily reflect an increasing degree of vertical coordination. To address this, an indicator (Figure 2) was defined, referred to as, the ‘vertical coordination indicator’. This indicator is calculated based on the five coordination forms, weighted by their relative position along the

2 Austria (AT), Belgium (BE), Brazil (BR), Canada (CA), China (CN), Czech Republic (CZ), Denmark (DK), Finland (FI), France (FR), Germany (DE), Hungary (HU), Ireland (IE), Italy (IT), Netherlands (NL), Poland (PL), Portugal (PT), South Africa (ZA), Spain (ES), Sweden (SW), United States (US) and Vietnam (VN).

coordination spectrum. Spot market transactions are in the first position (value = 1), followed by marketing contracts (value = 2), production and cooperative contracts in the same position (value = 3), and vertical integration in the last position (value = 4)<sup>3</sup>. The weight of each coordination form in each country was based on the average values of the market share ranges, adjusted to total 100% when necessary, as described above. Consequently, indicator value 1 represents 100% spot market coordination, while level 4 represents 100% vertical integration.

Complementing Figure 1 and the 'vertical coordination indicator' in Figure 2, a 'vertical coordination fragmentation index' was also calculated. This index seeks to measure how "spread out" or "concentrated" the vertical coordination structure is in each country. To calculate this index, the sum of the market shares of each form of vertical coordination squared is subtracted from one<sup>4</sup>. An index close to 0 indicates a structure highly concentrated in a few forms of vertical coordination, while an index close to 1 indicates a highly diversified structure with several forms of vertical coordination.

The usual producer' role presented in Figure 4 was assessed using four levels of influence ("no influence", "very limited influence", "influence via a cooperative or representative association"; and "rather big influence") across 10 different decision dimensions ("housing and handling standards"; "feed origin and formulation"; "origins of genetics"; "vaccines and medicines"; "environmental technologies"; "technical advice origin"; "volume produced"; "price or payment formula negotiation"; "contract negotiation"; "market intelligence"). Decision dimensions were ranked from the lowest to the highest overall degree of producer influence, considering all countries (from "no influence" to "rather big influence").

3 Production and cooperative contracts were ranked in the same position because neither was considered to have a higher degree of vertical coordination than the other. Even so, two other ranking criteria were also tested, which altered their positions on the spectrum of organizational forms, differentiating themselves and each being closer to or further from the spot market. In one alternative criteria the ranking was: spot market = 1; marketing contracts = 2; production contracts = 3; cooperative contracts = 4; vertical integration = 5. In the other criteria the ranking was: spot market = 1; marketing contracts = 2; production contracts = 4; cooperative contracts = 3; vertical integration = 5. The results commented in footnote 5 were quite similar to the first criteria, so they were not presented in this study.

4 The 'vertical coordination fragmentation index' ( $= 1 - \sum(\text{share}^2)$ ) is an adaptation of the Herfindahl-Hirschman Index (HHI) used to measure market concentration.

Expected market share trends over the next 10 years, presented in Figure 5, were reported using four categories ("decrease"; "stability"; "increase"; and "I don't know"). Other characteristics of each vertical coordination form (i.e., asset ownership, cost structure, payment methods, and the usual duration of the relationship) were described textually based on the analysis of questionnaire responses.

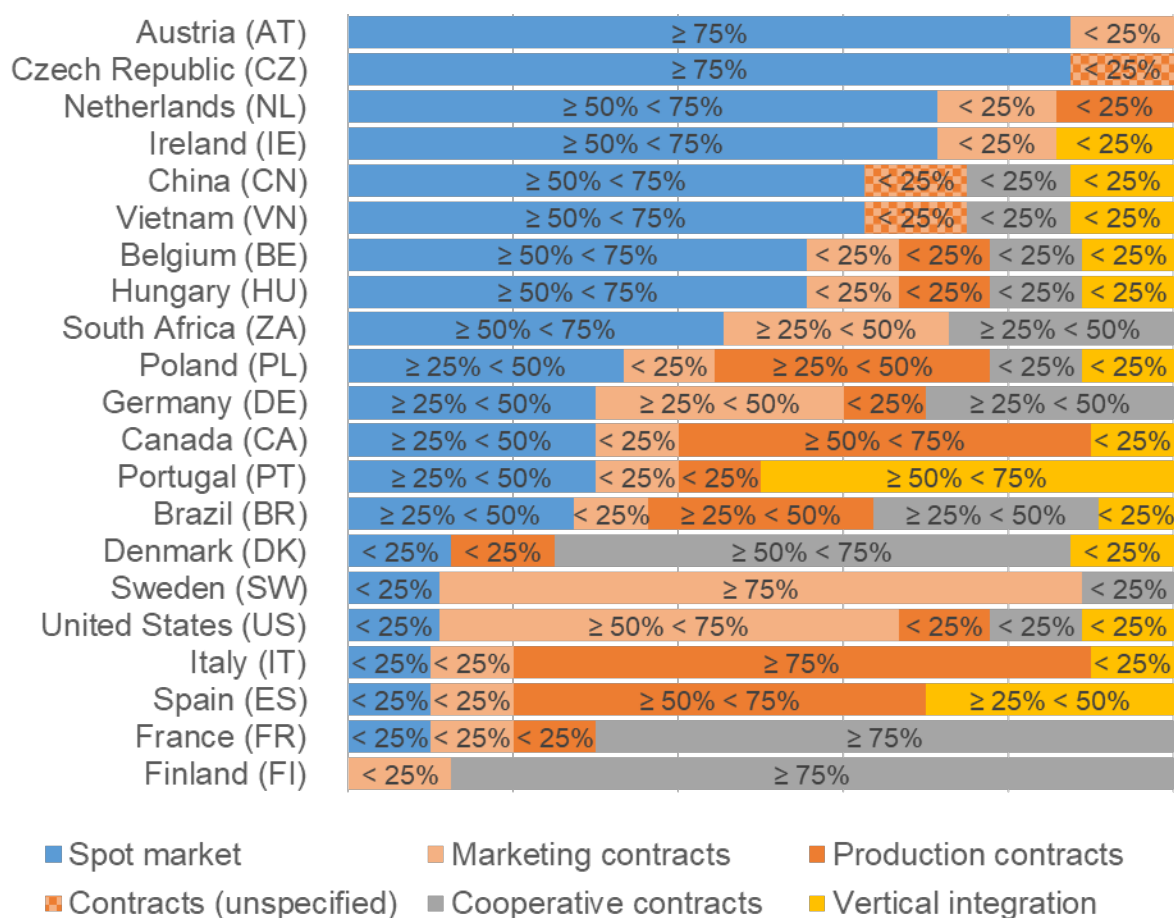
Finally, vertical coordination forms were used to group countries for the analysis as follows: (1) 50% or more spot market; (2) 50% or more marketing contracts; (3) 50% or more production contracts; (4) 50% or more cooperative contracts; and (5) 50% or more vertical integration. Countries where none of these vertical coordination forms predominate were classified as having a "mixed" organizational structure.

### Market shares

This section maps qualitative market shares of the main types of vertical coordination in pig production in each country. The spot market occurs in all but one of the countries studied, and in nine countries it represents 50% or more of production. The pig sectors in Austria and the Czech Republic are essentially based on the spot market (75% or more), while in Belgium, China, Hungary, Ireland, Netherlands, South Africa and Vietnam it represents the largest share (between 50% and 75%). Other coordination forms complement the spot market in these nine countries (Figure 1).

Contracts are present in all 21 countries, but generally with up to 25% of market share. However, in five countries they represent 50% or more of pig production, whereas in Sweden and the United States, marketing contracts, in Canada, Italy and Spain production contracts predominate. Cooperative contracts and vertical integration (full ownership) are not relevant in one third of the countries; however, in four countries they represent 50% or more of pig production. In Denmark, Finland and France, production is essentially based on cooperative arrangements, while in Portugal on vertical integration.

Although countries exhibit a wide variety of vertical coordination patterns, most have one or two predominant forms. However, three countries stand out for having at least four distinct forms of vertical coordination, but none holds 50% or more of market share. These "mixed" countries are Brazil, Poland, and Germany. Their pig sectors are based primarily on production contracts in the first two cases and on marketing contracts in the third, alongside spot market transactions and cooperative arrangements. In Brazil, cooperative contracts are almost



**Figure 1.** Indicative division of market shares of vertical coordination forms in pig production.

Source: authors based on InterPIG and agri benchmark pig members.

Note: countries for which contract type was not specified were marked with a light and dark, orange-checked pattern.

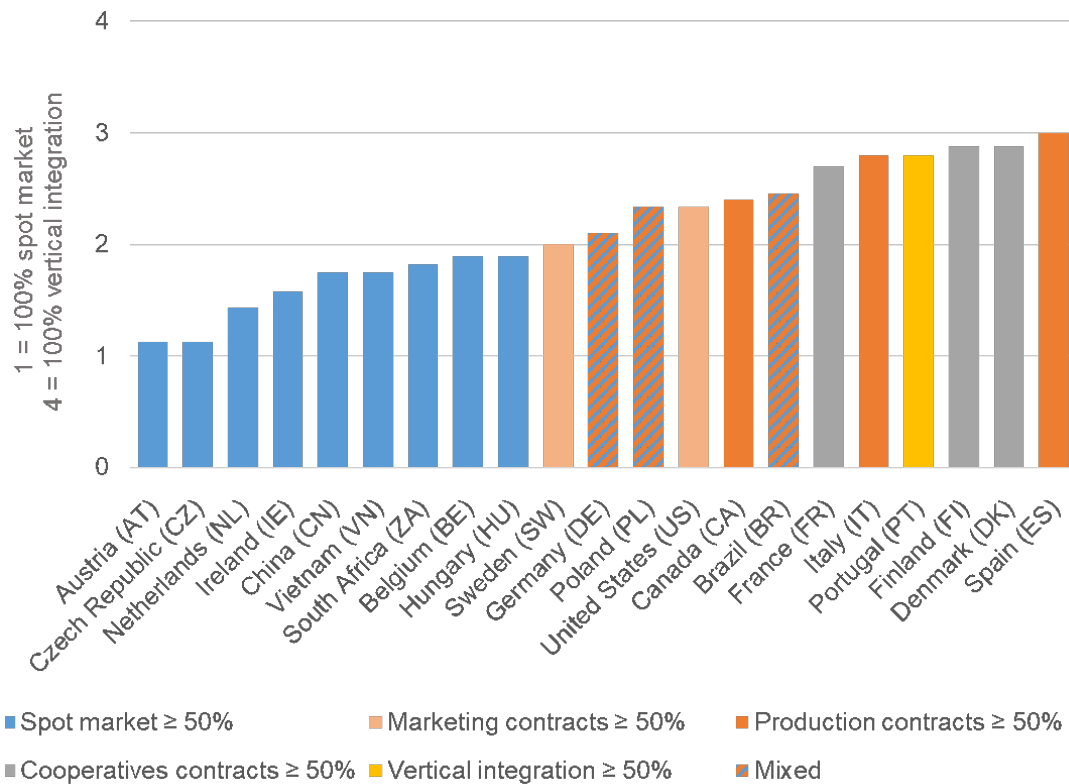
identical to production or marketing contracts and in Germany almost identical to marketing contracts, except that producers have greater influence in the direction of the cooperative through voting.

As expected, the 'vertical coordination fragmentation index' is highest in the three countries classified as "mixed", ranging from 0.72 to 0.76. On the other hand, countries with one form of vertical coordination with 75% or more of production showed the lowest fragmentation indices, ranging from 0.22 and 0.37. This includes Austria and the Czech Republic classified as "spot market", Sweden classified as "marketing contracts" and Finland classified as "cooperative contracts". The other countries presented indices ranging from 0.45 to 0.64, indicating diversity in vertical coordination, even when one form is predominant (i.e., with 50% or more participation in production), and independently on which form is predominant.

### Vertical coordination indicator

The vertical coordination indicator measures a country's relative position between the two ends of the organizational spectrum, where 1 represents 100% spot market coordination, and 4 represents 100% vertical integration (Figure 2). Countries characterized by predominance of the spot market ranged from 1.13 to 1.89; those with marketing contracts ranged from 2.00 to 2.33; those with production contracts ranged from 2.40 to 3.00; those with cooperative contracts ranged from 2.70 to 2.88; and the country characterized by vertical integration had a value of 2.78. As expected, among the three countries classified as "mixed", the indicator was at an intermediate level, between 2.10 and 2.45<sup>5</sup>.

5 These results were obtained using the criteria that classifies production and cooperative contracts in the same position (value = 3). Using the other two criteria mentioned in footnote 8, the cooperative countries (Denmark, Finland, and France) and those with production contracts (Italy and Spain) altered their relative positions. However, this had little impact on the final ranking.



**Figure 2.** Vertical coordination indicator in pig production, by country groups.

Source: authors based on InterPIG and agri benchmark pig members.

Note: production and cooperative contracts are assigned the same position on the spectrum of organizational forms; 1 represents 100% spot market coordination and 4 represents 100% vertical integration.

## Characteristics

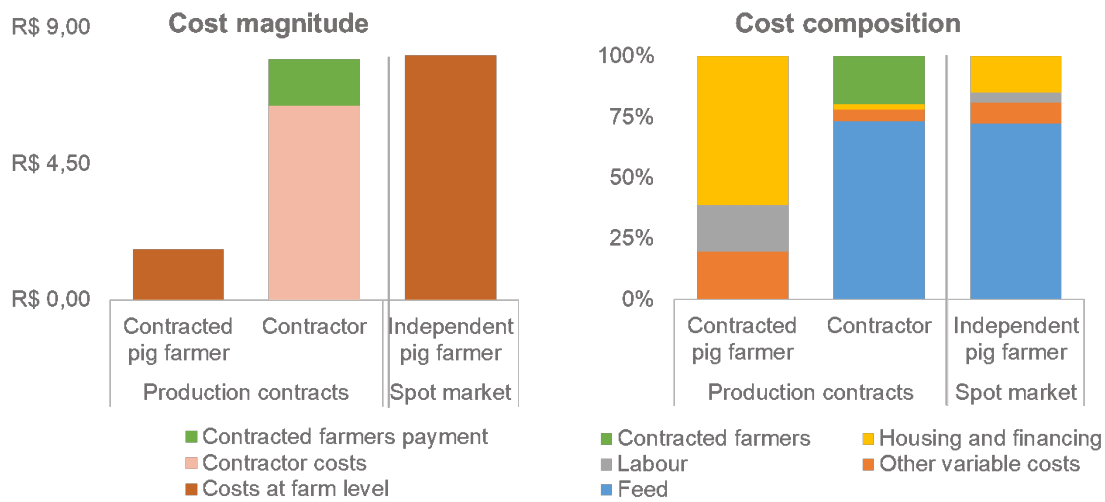
Pig farm asset ownership and cost structure are largely similar among independent producers operating in the spot market, those engaged in marketing and cooperative contracts, and vertically integrated firms. In these arrangements, independent producers retain full ownership of production assets (buildings, equipment, livestock, feedstuffs and feedstock), whereas under vertical integration the integrating firm (rather than the farm operator-manager) owns the assets and bears production costs. Responsibility for transport costs (bulk feed, piglets and slaughter pigs) varies greatly across countries and markets, and shows no consistent pattern, and may be embedded in the price of inputs or final products.

Pig farmers engaged in production contracts exhibit a different asset ownership and cost structure. Their assets are typically limited to buildings and equipment, and their costs generally include labor, some variable costs<sup>6</sup>, depreciation and financing expenses, but do not include feed, genetics, vaccines,

medicines, technical and veterinarian advice and transport, which are usually provided by the contractor. Consequently, the costs of raising pigs by independent producers differ substantially from those of contracted producers in production contract, both in composition and magnitude. Figure 3 illustrates these differences in Santa Catarina, Southern Brazil, where costs of independent pig farmers are compared to those of a contracted pig farmer tight to a contractor through production contracts (generally a slaughterhouse and meat processor or a feed mill).

Farmers' payment methods vary widely across vertical coordination forms and across and within countries. In general, payments combine quantity and quality criteria using various pricing mechanisms. Fluctuating quotations are most common in spot markets, where national or regional trading boards involving slaughterhouses and producer associations set weekly prices for slaughter pigs and piglets (either mandatory or as reference prices). Under marketing and cooperative contracts, the most common methods are market-based formulas linked to pig, piglet, pork, or feed prices, window or price floor contracts, and fluctuating quotations similar to those used in spot markets. Tacit agreements and

<sup>6</sup> Generally, electricity and heating, maintenance, insurance and manure handling



**Figure 3.** Cost magnitude and composition in pig production contracts and spot market, Santa Catarina, Brazil, 2024.

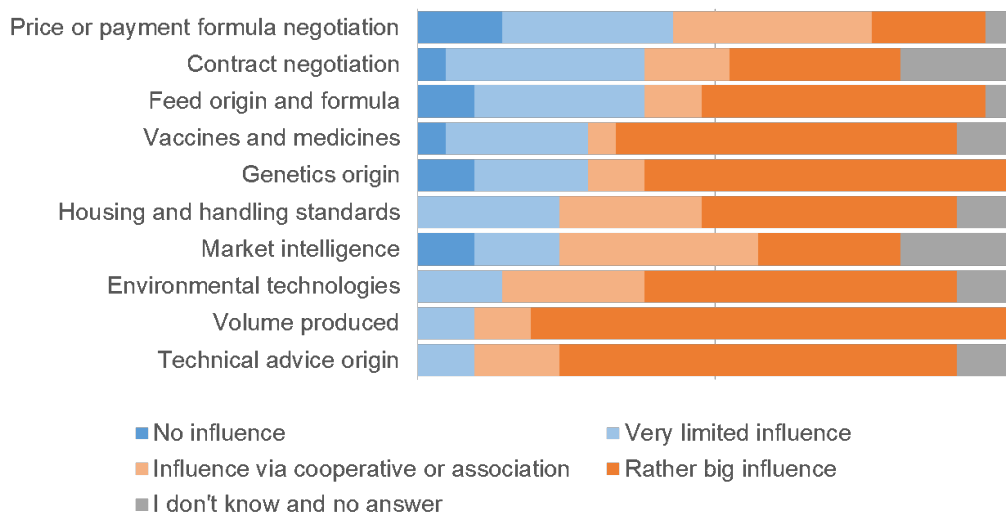
Source: adapted by authors from Embrapa Suínos e Aves (2024).

Note: total costs in Brazilian Reais per kg hot carcass weight; housing costs based on new investments (replacement value).

long-standing relationships between independent pig producers and buyers may also follow payment methods which are comparable to those used in marketing contracts. Payment methods in production contracts reflect the cost structure and asset ownership in this form of vertical coordination. The most common approaches include fixed fees, or cost-plus arrangements, or incentive payments (based mainly on performance targets and quality criterias) or, in some countries like Portugal and the United States, the space rental.

Considering all the different vertical coordination forms, producers typically have a lower level of influence in setting up or detailing the negotiation

(contract, price or payment formula), marketing intelligence, and feed origin and formulation, and a higher level of influence in the origin of the technical and veterinary advice, production volume, and environmental technologies (Figure 4). Comparing groups of countries, pig producers in countries where marketing and cooperative contracts predominate (50% or more) generally exhibit greater influence. However, there are clear differences within the groups, mainly the spot market countries and the “mixed” group of countries. It is important to highlight that, except for the group of nine spot market countries, all other groups have only two or three members, which limits the study's conclusions.



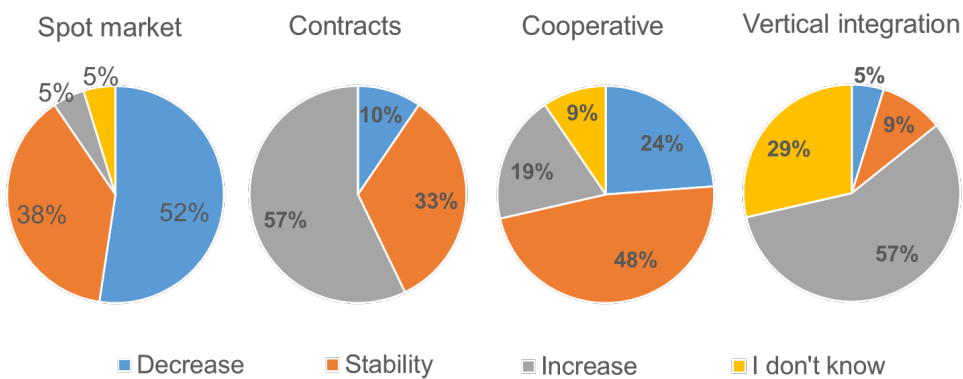
**Figure 4.** Pig producers' role by decision dimensions.

Source: authors based on InterPIG and agri benchmark Pig members.

Finally, the usual duration of the relationship between pig producers and buyers or contractors is shortest in the spot market arrangements (non-recurrent or short-term), longer in contractual arrangements (medium-term to long-term), and longest in cooperative arrangements, for which the largest number of countries report long-term relationships.

### Market shares trends

This section maps expected market share trends over the next 10 years. The results are based on expert judgment and reflect their individual views, and do not represent official positions nor binding commitments. In general, experts expect the share of the spot market to decrease or remain stable, contracts (marketing and production) to increase or remain stable, cooperative contracts to remain stable or decrease, and vertical integration (full ownership) to increase (Figure 5).



**Figure 5.** Trends in market share in pig production for each type of vertical coordination over the next 10 years.

Source: authors based on the individual views of InterPIG and agri benchmark Pig members; and do not represent official positions nor binding commitments.

Among the nine countries where the spot market accounts for 50% or more of the market, most expect a decrease in the share of this form of coordination (Austria, Belgium, China, Hungary and Vietnam), along with an increase in the share of contracts and vertical integration. The other four countries in this group (Czech Republic, Ireland, the Netherlands and South Africa) expect stability in the shares of the different coordination forms. However, South Africa expects a decrease in contracts and an increase in vertical integration, while the Czech Republic expects a decrease in cooperative contracts.

Among the three "mixed" countries and the five countries where contracts account for 50% or more of the market, only one is expected to experience a decrease in the share of contracts (the United States), while in the others, the share of contracts

is expected to increase (Brazil, Canada, Germany, Italy and Sweden) or remain stable (Poland and Spain). In almost all of these eight countries, a decrease in the share of the spot market and an increase in vertical integration are expected, except in Italy and in Sweden. For cooperative contracts, most countries expect stability, except Sweden (decrease), and Brazil and Germany (increase).

In the three countries where cooperatives account for 50% or more of the market, a decline in this form of coordination is expected in Denmark, while stability is expected in Finland and France. In none of these countries a decrease is expected in other forms of vertical coordination; only stability or growth is anticipated. Finally, in the country where vertical integration accounts for 50% or more of the market (Portugal), an increase in this form of coordination is expected, together with stability in the spot market and contracts and a decrease in cooperative contracts.

### Final considerations

For the countries included in this research, spot markets and contracts (both marketing and production) are the most common forms of vertical coordination, followed by cooperative contracts and vertical integration. Despite the diversity reported, this typology

makes it possible to classify almost all countries according to their dominant vertical coordination form, except for some with a "mixed" organization, where no single form of vertical coordination predominates. Their main differences in characteristics lie between production contracts and the other forms of vertical coordination, which are often similar to each other in terms of asset ownership, cost structure, and payment method. As illustrated, from the farmers' point of view, there is a clear difference in the magnitude and composition of the total costs, with implications for risk exposure, working capital requirement and producer's influence. In a production contract relationship, the pig farmer does not bear (part of) the market risk, which is transferred to the contractor (usually slaughterhouses or feed mills).

In general, experts expect an increase in contracts and vertical integration at the expense of the spot market over the next ten years, together with the relative stability in cooperative contracts. However, there are significant differences across countries and country groups. There is some logic behind a transition to somewhat more (formal) supply chain cooperation: the market volatility for pig meat and to some extent also for feed ingredients has strongly increased, forcing farmers and industry to search for stability and resilience. Other factors to consider include the increase and greater complexity of quality and traceability standards, as well as limitations in human and financial resources on smaller-scale farms.

Although specific types of vertical coordination exist in each country – depending on national characteristics, legislation, land and agricultural structure, industrial organization, and historical development – these coordination forms are not mutually exclusive and may occur simultaneously within the same region or even within the same company or cooperative. Furthermore, many countries show combined coordination models, with cooperatives, vertical integration and production contracts linked in the same supply chain. Therefore, a diversity of situations underlies this qualitative overview.

Furthermore, coordination can be achieved in many ways, and may be defined differently across countries or even across regions within the same country, with similar terminology used to describe distinct forms of vertical coordination. Marketing and production contracts represent two fundamentally different forms. The former extends the spot market to manage risk, whereas the latter represents an extension of the contractor firm to organize production. Vertical integration and production contracts are also distinct forms of coordination, however, in everyday practice, both are often referred to as “integration” by market participants. In some countries, such as Brazil, the legislation itself defines vertical coordination through production contracts as “vertical integration or integration”, reflecting the usual terminology used by practitioners, but not in accordance with theoretical definitions. Legislation in France also uses the term “integration contracts”. By contrast, cooperative contracts in many countries are almost identical to marketing or production contracts, except that producers have greater influence through voting rights. It is also important to highlight that vertical integration refers in this study to a full ownership supply chain (feed-farm-pork), but closed cycle farms (or

farrow-to-finish systems) can also be ‘vertically integrated’ with feed mill, crop production, and/or own butchery.

Finally, the proposed vertical coordination indicator measures countries’ relative position along the organizational spectrum. This does not imply that systems characterized by spot markets may lack coordination, which may also take horizontal forms, such as well-organized producer associations, public and private standards, long-term relationships (reputation), and competition regulation. Austrians and Germans producers are horizontally cooperating in price-setting, resulting in a more balanced price-setting mechanism than in other spot market countries. Coordination may also be financial, through shared ownership in upstream and downstream activities, like cooperatives.

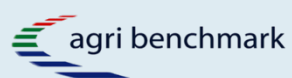
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