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Economic impact of university veterinary diagnostic laboratories: A case study

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ABSTRACT

Veterinary diagnostic laboratories (VDLs) play a significant role in the prevention and mitigation of endemic animal diseases and serve an important role in surveillance of, and the response to, outbreaks of transboundary and emerging animal diseases. They also allow for business continuity in livestock operations and help improve human health. Despite these critical societal roles, there is no academic literature on the economic impact of VDLs. We present a case study on the economic impact of the Iowa State University Veterinary Diagnostic Laboratory (ISUVDL). We use economic contribution analysis coupled with a stakeholder survey to estimate the impact. Results suggest that the ISUVDL is responsible for $2,162.46 million in direct output, $2,832.45 million in total output, $1,158.19 million in total value added, and $31.79 million in state taxes in normal years. In an animal health emergency this increases to $8,446.21 million in direct output, $11,063.06 million in total output, $4,523.70 million in total value added, and $124.15 million in state taxes. The ISUVDL receives $4 million annually as a direct state government appropriation for operating purposes. The $31.79 million in state taxes in normal years and the $124.15 million in state taxes in an animal health emergency equates to a 795% and 3104% return on investment, respectively. Estimates of the economic impact of the ISUVDL provide information to scientists, administrators, and policymakers regarding the efficacy and return on investment of VDLs.

1. Introduction

Much of the work done by veterinary diagnostic laboratories (VDLs) is routine and contributes to animal agriculture by allowing for the movement of animals, diagnosis of disease, prevention and treatment of disease, and ongoing monitoring of the health status of animals. The work of VDLs becomes much more crucial when trade-limiting diseases occur. Under these circumstances, it might be impossible to send samples to other states for testing, and the presence of a VDL that rapidly identifies, helps control, and treats a disease is critical to the financial performance of the animal agriculture industry.

Funding to support VDL operations is typically derived from clinical diagnostic service fees and contracts and government appropriations. Whether these appropriations, or tax dollars, provide a sufficient return on investment depends on the contribution of VDLs to the productivity, growth, and ultimately size of an animal agriculture industry, which subsequently generates taxes that offset spending. The aim of this study is to provide a simple and transparent method to estimate the economic impact of VDLs, something currently absent in the literature. The Iowa State University Veterinary Diagnostic Laboratory (ISUVDL) is used as a case study. The ISUVDL was selected as a case study because it is located in one of the most intensively populated animal agriculture regions in the nation. As a result, the Iowa economy is highly dependent on the animal agriculture industry, which amplifies the importance of the economic impact of disease outbreaks.

2. The role and activities of the ISUVDL

Animal agriculture includes raising of livestock to provide meat, milk, fiber, and other products to consumers. Iowa is a major producer and net exporter of beef, pork, poultry, dairy, and egg products. Iowa hog and pig production totaled 12,511 million pounds (5,674,732 metric tons) in 2015 (USDA-NASS, 2016a). Iowa cattle and calf production totaled 1904 million pounds (863,708 metric tons) in 2015 (USDA-NASS, 2016a). In 2015, Iowa raised 9.1 million turkeys or 354 million pounds (160,567 metric tons) of turkey production (USDA-NASS, 2016b). Iowa sold for slaughter 11.3 million chickens, or 37 million pounds (16,904 metric tons) of chicken production, in 2015 (USDA-NASS, 2016b). Iowa egg production totaled 12,463 million eggs in 2015 (USDA-NASS, 2016b). Iowa produced 4841 million pounds

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(2,195,841 metric tons) of milk and 184 million pounds (83,234 metric tons) of milk fat in 2015 (USDA-NASS, 2016c).

The ISUVDL's services are used to help clientele enhance the health and well-being of their animals and business operations. The ISUVDL processes more than 75,000 case submissions and conducts more than 1.2 million diagnostic assays per year (personal communication, Dr. Rodger Main, Director of ISUVDL). Many of the diagnostic tests at the ISUVDL are conducted for complying with the regulations for the transportation, exhibition, and sale of animals and animal products. Examples include mandatory tests for salmonella enteritidis, tests for exhibition and interstate and international transportation of animals, and certificates of veterinary inspection. These tests are all routine, and many businesses would not be able to operate without them. These movements have also effectively integrated animal agriculture across state lines, thus allowing for specialization and reduction of costs. The ISUVDL is one of 11 Tier 1 laboratories in the United States National Animal Health Laboratory Network (USDA-NAHLN, 2011). Therefore, it also plays a role in various national programs for the surveillance of, and response to, diseases that affect animal productivity, trade, and public health.

Responding effectively to emerging and transboundary diseases requires surge capacity and diagnostic research to develop and validate new tests that are not available in private facilities within the state. The United States has experienced several emerging and transboundary diseases recently. Between 2013 and 2016 outbreaks of infectious animal diseases in the United States included porcine epidemic diarrhea (PED) virus, highly pathogenic avian influenza (HPAI) and Seneca virus A, which is a vesicular disease resulting in an unprecedented number of disease investigations for Foot and Mouth Disease (FMD). During the outbreak of HPAI in 2015, the ISUVDL provided large-scale tests of suspected flocks (Main et al., 2015). Poultry identified as positive were eliminated, and the disease was successfully controlled (USDA-APHIS, 2015). Sales of eggs from farms free of the disease would not have been possible without this testing. When PED virus emerged in 2013 (Stevenson et al., 2013), testing at the ISUVDL dramatically increased.

Animal agricultural in Iowa depends on the extensive movement of livestock. For example, approximately 46.6 million hogs and pigs were marketed in Iowa in 2015 (USDA-NASS, 2016a); and, 27.5 million hogs and pigs were brought into Iowa for feeding or breeding purposes. Cattle and calf marketings totaled 2.2 million in 2015, and 1.5 million cattle and calves entered the state that year (USDA-NASS, 2016a). Any factor that might restrict their export and out-of-state sales would be detrimental to the economy. Diseases such as African swine fever (ASF), classical swine fever (CSF), FMD, and HPAI are highly disruptive, trade-limiting diseases. The ISUVDL provides diagnostic support for the nation and the state during the incursion of such diseases. This may enable the transportation and sale of unaffected animals and animal products during a disease outbreak.

During an outbreak of disease, comprehensive surveillance and regionalization (zoning), when allowed, may be used to maintain safe trade in animal and animal products as was done during the HPAI outbreak in the United States in 2015 (Swayne et al., 2017). Countries that import from the United States would stop the import of diseased animals and animal products but may allow imports from regions proven free of the disease. Regionalization requires large-scale and rapid test methods that can be provided by the ISUVDL.

3. Materials and methods

This study employs a two-step analysis. First, economic contribution analysis is used to quantify the portion of the Iowa economy supported by the animal agriculture industry. Estimates of state government tax collections are generated from these economic contributions. In the second step, these contributions and tax collections are compared to stakeholder survey estimates of how much the ISUVDL contributes to the overall economic value of the animal production and processing sectors in Iowa. This provides a simple and transparent estimate of the economic impact of the ISUVDL, and an estimate of the return on investment of tax dollars spent on ISUVDL operations.

3.1. Economic contribution analysis

Economic contribution analysis is a method used to estimate the portion of the economy supported by existing businesses or industry sectors. IMPLAN®, which is an input-output model of the regional economy (IMPLAN®, Huntersville, NC) is used to complete the analysis. For the purposes of this analysis, economic contributions arise from the change in producer revenue caused by animal production sector and animal products processing sector gains or loses. When the sectors earn revenue through sales increases, that revenue is spent throughout the regional economy on wages, agricultural inputs, and consumption of goods and services. Therefore, if the sectors' revenues rise, so too will revenue and employment in other sectors of the economy. Input-output models allow for the estimation of direct, indirect, and induced effects by establishing the links between various sectors of the economy. See Miernyk (1965) and Shaffer (2010) for more discussion of input-output modeling.

Input-output models are a popular economic tool used in modeling economic contributions of animal agriculture (Knudson and Peterson, 2012; Decision Innovation Solutions, 2015, 2016; Milhollin et al., 2016; Indiana Business Research Center, 2017), veterinary medicine (Chastain et al., 2002; Tuck et al., 2012; Beyer et al., 2013; Hall, 2015), and animal disease outbreaks (Garner and Lack, 1995; Ekboir, 1999; Caskie et al., 1999; Mahul and Durand, 2000; Pendell et al., 2007).

The data used for input-output analyses are reasonably contemporaneous as they are based on the quarterly census of employment and wages data continuously collected and compiled by the U.S. Bureau of Labor Statistics, as well as: (*a*) a range of ongoing industrial surveys by the U.S Department of Commerce, the U.S. Bureau of Economic Analysis (BEA), the U.S. Department of Transportation, and the U.S. Department of Agriculture; (*b*) a range of other income-related data compiled at the state and substate levels by BEA; and, (*c*) the benchmark U.S. input-output tables that are updated quinquennially by BEA. These data provide the analytic foundation for the input-output model of the regional economy.

The model base data were for 2014. Animal production data were updated to reflect gross sales in 2015. Five categories for animal production were modeled: (*a*) swine; (*b*) cattle and calves; (*c*) poultry and eggs; (*d*) dairy cattle and milk; and, (*e*) all other animals. All other animals includes sheep and lambs, goats, equine, and all other animals.

The animal products processing (also referred to as manufacturing activity that depends on animal production as inputs) data were for 2014 and organized into three cohesive groups from several individual subsectors in the modeling system: (*a*) animal slaughtering and processing; (*b*) milk, cheese, ice cream, and all other related processed milk products processing; and, (*c*) poultry slaughtering and processing.

The animal production and the animal products processing industries all have strong buy-sell linkages with one another. The cattle sector, for example, buys animals from the dairy sector and vice versa. Animal products processing obviously buys animals and they buy from one another, as well. Accordingly, it is important to specify the modeling structure so that double counting is eliminated when estimating separate sector and combined sector economic contributions. The animal production and the animal products processing sectors were carefully modified in the model to minimize double-counting. These model modifications were done within the animal production sectors, between animal production and animal products processing sectors, and within the animal products processing sectors.

The modeling process produces estimates of labor income, which are payments made to all affected workers and proprietors. Labor incomes are subject to state personal income taxes, and the conversion of those incomes into household spending results in additional sales, use,