A Virus Without Borders: Potential Economic Impacts of African Swine Fever in the United States

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African swine fever (ASF) is a highly contagious viral disease affecting domestic pigs and wild boar, and it has become one of the most disruptive transboundary animal diseases for the global pork sector. For major exporters, economic risks arise not only from animal losses and production interruptions, but also from sudden and potentially prolonged restrictions on market access. Trade partners' risk perceptions and policy responses can extend beyond the minimum timelines determined by international standards, making the duration of export disruptions a central determinant of economic outcomes for affected exporters and their trade partners. In this context, the U.S. is particularly exposed given the country's large, geographically concentrated hog industry and the U.S. role in global pork trade.

This paper develops a dynamic, economy-wide assessment of a hypothetical ASF outbreak in the U.S. in 2024, using a global, recursive dynamic computable general equilibrium (CGE) framework. The contribution is motivated by two gaps in the existing animal disease-economics literature. First, CGE analyses of animal disease impacts have historically focused on foot-and-mouth disease and have often relied on static or single-country frameworks, where exports may be aggregated and region-specific trade adjustments are limited. Second, fully global, dynamic models that jointly capture medium-term macroeconomic adjustments and bilateral trade reallocations are limited, despite the inherently international nature of animal disease shocks. By applying a global, recursive dynamic CGE model to a U.S. ASF scenario, we quantify how production losses, export restrictions, and upstream commodity market effects propagate across sectors and regions over a five-year horizon, and how these impacts vary with outbreak severity and the speed of trade recovery.

The analysis is implemented in the GTAP recursive dynamic framework and evaluated in deviations from a no-disease baseline path. We simulate a hypothetical ASF outbreak occurring in 2024, and we compute year-by-year impacts relative to a counterfactual baseline projection over the horizon of the study. The outbreak enters the economy through two primary channels: (i) decreases in hog production arising from mortality and depopulation, and (ii) restrictions on U.S. access to export markets for hogs and pork. In addition, we evaluate a secondary channel in which sanitary risk perceptions spill over into upstream feed grain trade, motivated by evidence that some importing countries have imposed restrictions on grain imports from ASF-affected regions and that animal disease events can generate measurable soybean export losses.

Our database construction begins from version 12 of the GTAP database, calibrated for 2023, with 65 sectors and 160 regions. The no-ASF baseline projection begins in 2024 and extends through 2028, maintaining the 2023 structure while projecting macroeconomic and trade trends using World Bank macro projections and OECD-FAO agricultural outlook trajectories. This baseline provides the counterfactual path against which all ASF scenarios are evaluated year by year.

Because the standard GTAP sectors do not include dedicated hog and pork sectors, we disaggregate sectors to better capture ASF's direct incidence. Specifically, the "other animal products" sector is split into "hogs" and "live poultry and other animals," and the "other meat products" sector is divided into "pork" and "poultry and other meat," expanding the database from 65 to 67 sectors. These 67 sectors are subsequently aggregated into 12 broader sectors for this analysis, which include feed, other agricultural products, cattle, hogs, live poultry and other animals, beef, pork, poultry and other meat, other processed foods, other primary products, manufacturing, and services. Additionally, the original 160 regions are aggregated into 12 key regions reflecting major exporters and importers in the global pork market, including the U.S., Canada, Mexico, Brazil, China and Hong Kong, Japan and South Korea, the European Union, Association of Southeast Asian Nations (ASEAN), and the Rest of the World. This aggregation is designed to retain the main bilateral trade relationships relevant for U.S. pork exports while allowing the model to represent trade diversion and substitution patterns among leading exporters and importers.

Scenario design follows the epidemiological and economics literature documenting heterogeneity in ASF severity and persistence across settings, ranging from severe herd reductions as observed in China's 2018-2019 outbreak to smaller average herd declines observed during ASF outbreaks in parts of Europe. For the U.S. context, we anchor one scenario to epidemiological simulations from PigSpread-ASF. In particular, the worst-case control scenario in Sykes et al. (2023), combining depopulation, contact tracing, movement bans, and depopulation of contact herds, eliminates approximately 700,000 hogs, about 0.93% of the 2023 U.S. hog inventory, providing an example of a relatively small national production shock under intensive control measures. Guided by this literature and the broader range of international experiences, we simulate three alternative hog production shocks: a small national shock of 0.93% with full recovery by 2026; a moderate, spatially concentrated shock corresponding to 10% depopulation of Iowa's hog inventory (a 3.2% national herd reduction) with recovery by 2027; and a severe shock corresponding to 40% depopulation in Iowa (a 13% national herd reduction) with recovery five years after the outbreak. These alternatives are intended to represent a range of outbreak severities while explicitly representing recovery dynamics over time rather than imposing a one-period shock.

The second channel, given by export restrictions, reflects that notifiable animal disease events can lead to sharp reductions in exports and that the duration of trade disruptions can vary substantially. For the U.S., prior work has examined cases ranging from a two-year export ban to scenarios in which trade restrictions persist for a decade, highlighting the uncertainty around market reopening. In our simulations, we impose a 35% reduction in U.S. hog and pork exports in the outbreak year, representing Iowa's share of U.S. pork exports in 2023. For each hog production shock, we consider two alternative export recovery paths: a fast recovery case in which exports return to baseline three years after the outbreak and a slow recovery case in which trade partners maintain restrictions for four years and export volumes recover more gradually.

In two alternative scenarios, we add a negative shock to feed exports in the slow-recovery cases to capture the possibility that sanitary risk perceptions extend beyond hog and pork products. Motivated by estimates of disease-associated soybean export losses and documented restrictions on grain imports from ASF-affected regions, we introduce a 2% decrease in U.S. feed exports in the year of the outbreak,

combined with the hog production shocks when pork export recovery is slow. The resulting design yields nine scenarios that vary along three dimensions: the magnitude and duration of hog production shocks, the speed of recovery in hog and pork exports, and the presence or absence of the feed export shock.

The main results of this study include deviations from the baseline path for sectoral production (hogs, pork, and related sectors), domestic and world prices, and bilateral trade flows over the analysis period (2024-2028). The comparative scenario design is intended to isolate the relative importance of production disruption versus market-access losses and to illustrate how persistence in trade restrictions amplifies or prolongs economy-wide impacts.

We make three main contributions to the literature. First, this study provides the first economy-wide assessment of a hypothetical ASF outbreak in the U.S. using a dynamic global CGE model. This work fills a critical gap left by previous U.S. studies that rely on partial-equilibrium or input-output frameworks and therefore do not account for broader macroeconomic linkages and bilateral trade adjustments. Second, our analysis incorporates the main transmission channels through which ASF affects economic outcomes, including supply disruptions in animal and meat sectors, the loss of export market access, and upstream feed market linkages, highlighting how these shocks propagate to global trade reallocation. Third, we evaluate a set of policy-relevant outbreak scenarios that vary in severity, offering comparative results for key economic indicators affecting producers, consumers, and trade partners over time. More broadly, the modeling framework is adaptable for assessing other transboundary animal diseases and offers a decision-support tool for prioritizing disease prevention and response investments under uncertainty.