AFRICAN SWINE FEVER

The medium-term effects on agricultural markets
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Introduction

The outbreak of African swine fever (ASF) in China has left a marked footprint on regional and global meat markets in southeast Asia. In principle, ASF tends to reduce feed demand and puts downward pressure on feed grain and feed protein prices; at the same time, it supports meat and dairy prices. The outbreak of ASF in China has confirmed these effects, in practice. In fact, by early August 2019, pork prices in China had increased by more than 25 percent from the previous month (Hancock, 2019) and by more than 50 percent in the past year (August 2018) (Craymer, 2019). In response, the national authorities resorted to emergency measures by releasing frozen pork from a strategic pork reserve in late August 2019 to stabilize prices (Hancock, 2019). As pork is the main source of protein in China, production declines from emergency culling and rising prices are genuine concerns for national food security.

China is among the world leaders in pork production and consumption, accounting for roughly half of the global pig herd. China also plays an important role in global commodity markets to support its pork production with feed grain and oil meal. Therefore, ASF is a threat to disrupt Chinese meat consumption patterns. Its impact will likely be felt worldwide, affecting all commodity markets. The disease could remain endemic for decades in the region and is likely to spread further within and beyond the region.

In the short-term, supply deficits and rising prices may be stabilised by pork reserves and other measures (pre-emptive culling). However, how will the pork protein gap be filled in the medium term once short-term measures are no longer effective? How will feed and protein markets adjust to ASF over the medium term? How will the complex tangle of substitutions and complementarities both within the grain and feed markets and across related markets, such as those for biofuels, evolve over several adjustment periods? Forecasting the impact of ASF across commodity markets can help policymakers to address the protein gap and adjust to other changes in commodity markets.

This paper aims to gauge these complex cross-commodity and cross-country effects over the medium-term, that is, within a ten-year time horizon. While focusing on meat and feed markets, it also assesses the effects of ASF on all agricultural markets. The results are based on a number of counterfactual runs undertaken with the Aglink-Cosimo model, a global partial equilibrium framework jointly maintained by the secretariats of the Food and Agriculture Organization of the United Nations (FAO) and the Organisation for Economic Co-operation and Development (OECD). The results will help decision makers to understand the extent to which ASF is likely to affect the various agricultural markets and help them prepare for the challenges and the opportunities that may arise from a further spread of the disease. The effects will be presented in three scenarios. All three scenarios make country-specific assumptions on the speed and extent of the spread of ASF as well as options to contain its proliferation. These assumptions are based on the biosecurity status of different countries and their ability to handle the disease, such as to maintain production while controlling and combatting an ASF outbreak.
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Background

ASF was detected\(^1\) in Georgia in April 2007, and then spread to Armenia and further north at a speed of about 50 km per month to reach the Chechen Republic of the Russian Federation in November 2007. It continued to spread and reached Azerbaijan in January 2008, the Ukraine in July 2012, Belarus in June 2013, and finally the European Union in 2014. ASF spread to the Baltic states during 2014 (Lithuania, Poland, Latvia and Estonia) and other Eastern European countries from 2016 to 2018 (Moldova, Czech Republic, Romania, Hungary and Bulgaria). In July 2019, ASF arrived in Slovakia and in Serbia. It is now endemic in almost all of the eastern part of the European Union. In western part of the European Union, ASF was suddenly detected in wild boars in Belgium in September 2018 and continued to be detected till the COVID-19 lockdown started; and arrived in Greece in February 2020. ASF is not new to Europe. In fact, its first occurrence outside of Africa was in Portugal in 1957 (Costard et al., 2009). It remained endemic on the Iberian Peninsula (Spain and Portugal) until the mid-1990s and it is still endemic in Sardinia (Laddomada et al., 2019), where it was first found in 1982. Short outbreaks of ASF were also reported in a number of other European countries, including Malta (1978), Italy (1967, 1980), France (1964, 1967, 1977), Belgium (1985) and The Netherlands (1986).

ASF is also not new to Latin America. It was reported in Cuba in 1971 (Seifert, 1996), where it was believed to have been introduced from Spain. It was reported in several other Caribbean islands in the late 1970s, the Dominican Republic in 1978, and Haiti in 1979, where its latest occurrence dates back to 1984 (Wilkinson, 1989). ASF was reported in Brazil in 1978, and was probably introduced from Spain or Portugal through food waste carried by transcontinental flights and/or animal products imported by tourists (Lyra, 2006). The date of the last reported occurrence was 1981.

In parallel, ASF continued to spread within Africa in the 2000s, reaching previously uninfected countries, including the Indian Ocean islands of Madagascar and Mauritius. A large outbreak is recently reported in Nigeria. Given the continued occurrence of ASF in sub-Saharan Africa and increasing global movements of people and products, the continued transcontinental transmission is not surprising.

While ASF spread throughout much of Europe, Latin America, Africa and Siberian parts of Russian federation, Asia remained ASF-free until 2018. In August 2018, ASF first appeared in China and was later reported in Viet Nam in February 2019. With these two countries, it hit the world’s largest and fifth-largest pig producers, respectively. Since then, ASF has spread to Mongolia (January 2019) and Cambodia (March 2019). ASF was detected in a slaughterhouse in Hong Kong SAR, China, and reached the Democratic People’s Republic of Korea (May 2019), Lao People’s Democratic Republic (June 2019), the Philippines (July 2019), Myanmar (June 2019), Indonesia, Timor-Leste, the Republic of Korea, (September 2019), India (February 2020) and Papua New Guinea (March 2020). The FAO Emergency Prevention System for Animal Health (EMPRESS-AH) closely follows the spread of ASF throughout the world, offering advice on preventing, containing and combatting the disease.

\(^1\) The country prevalence of the ASF is sourced from the OIE World Animal Health Information System (WAHIS).
Arguably the most important change in the epidemics of the disease came with the fast spread to and within China and other countries in southeast Asia, East Asia, Islands in Pacific, and South Asia. A number of factors have facilitated the speed and far-reaching spread of the disease in southeast Asia. First, many southeast Asian countries have high to very high stocking densities, which makes it easy for the virus to spread. Second, current husbandry practices in many southeast Asian countries fail to provide the biosecurity standards that are required to effectively contain the disease. In most countries of the region, pig production is still dominated by small, “backyard” operators that often keep their pigs outside of confined environments and feed them with table scraps or uncooked organic refuse (“swill feeding”). The ASF virus survives a long time in meat, organs, blood, bone marrow, ham/sausage/dried meats, and dried blood, among other items, and can infect pigs that eat these items. There is also a lack of vertical integration, which means that piglets and sows are transported between farms and sometimes across regions, further supporting the rapid spread of the disease over a larger distance. The virus can spread through infected or ill animals or contaminated vehicles and equipment (inanimate objects known as “fomites”).

A lack of local specialization not only supports the spread of the disease, it also impedes the continuation of production, where ASF is endemic. Production can be maintained in “compartmentalised” systems, for example, systems where interactions between farms are minimal or entirely absent. There is also a lively intra-regional exchange of all sorts of pork products, including sausages, cured meats and other processed pig meat products. These products may contain the ASF virus, which is highly resistant to temperature, environmental factors and treatments (salting) and can persist for months or years in organic matter. This means that the chances of ASF spreading far and fast in Asia are high, and the disease may resurface in the region up to years after the initial outbreak.

Assessing African Swine Fever (ASF) in a counterfactual analysis

There are already a number of analyses that have described the immediate short-term impacts of ASF on meat and feed markets (Rabobank, 2019b; Schmidhuber, 2019a; and USDA, 2019). The fundamental limitations of all these assessments is that they compare a situation before an ASF outbreak with one after an ASF outbreak. They therefore capture a confluence of factors that took place in parallel with the spread of the disease, notably the trade conflict between China and the United States of America, the adverse weather conditions at the beginning of the United States of America sowing season or the appreciation of the US dollar against almost all currencies, notably the Chinese Yuan.

The model-based simulation adds value to these short-term analyses in a number of ways. The first is to isolate the ASF impacts from all other effects taking place in parallel. Unlike the short-term assessments, the model-based analysis compares a counterfactual, that is, a “with vs without” not a “before vs after” comparison. The second is that a model-based approach gauges the effects that arise from all the interactions between all other commodity markets affected by the ASF shock, assesses their global effects and does so in a consistent manner across countries and commodity markets. Lastly, the model captures the dynamics caused by an important disruptor and its effects over time, from the start date until 2030.
The medium-term impacts

The basic scenarios and their underlying assumptions

The past and current disease dynamic was systematically reviewed in conjunction with all possible factors that could help to contain the spread of the disease. In collaboration with the Animal Health Service led by the Chief Veterinary Officer of FAO, they were translated into country-specific trajectories of pig herd developments and pork production. Three basic scenarios are distinguished.

The first scenario (scenario 1) captures the likely impacts of ASF on all countries already affected by the disease, which are not captured in the baseline projections to 2028. The main thrust of this scenario is to gauge the 2018 and 2019 outbreaks in a number of countries in southeast Asia, notably in China and Viet Nam, two globally important producers. For those countries in East and southeast Asia that are not yet affected, notably Thailand, it is assumed that ASF will appear in 2020 and then take a path that reflects the country-specific factors that determine the spread and containment. As described above, these include inter alia biosecurity, degree of vertical integration, compartmentalisation of production, stocking densities and overall veterinary preparedness.

The second scenario (Scenario 2) builds on the first by assuming that ASF will leave a much deeper initial footprint in China. These assumptions reflect the expectations voiced by numerous analysts and observers (Gu & Singh, 2019). This second scenario also assumes that the deeper initial footprint gives rise to a faster structural change in ensuing years, enabling the country to control the disease more effectively and eventually produce more competitively, in larger units, at lower overall costs and with the ability to contain a further spread of the disease.

The third scenario (scenario 3) returns to the assumptions made for China in the first scenario, that is, a more moderate impact, but assumes that ASF will spread further within and outside of the currently affected regions, and eventually reach all major producing areas. This includes all the countries in the European Union that are still ASF-free. Importantly, it also assumes that ASF returns to the Americas, recurring in the Caribbean and Brazil, and spreading to all major producers in North and South America. However, in the return to the Americas, the assumptions reflect a much-improved biosecurity status, allowing most of the affected countries in the region to swiftly overcome the initial shock, contain the spread and continue production. All newly affected countries in the third scenario are assumed to be affected by 2024. This is an arbitrary assumption, setting the start of the outbreak conveniently in the middle of the outlook period.

2 The current baseline assumes that the impacts of ASF are largely limited to China, that they are small overall and disappear again after a period of three years.

3 Australia, New Zealand and parts of the Pacific region have been excluded from the global spread scenario, reflecting their high biosecurity status and insulated geographic positions.
The country-specific assumptions for all three scenarios are depicted in the Annex of this paper. It should suffice here to depict a few idiosyncratic trajectories, such as those that reflect the assumptions that determine the different speeds of spread and recovery from the disease.

China

Arguably, the greatest uncertainties arise from China’s meat market in general and its pig meat market in particular. China accounts for about 50 percent of the global pig herd and nearly the same percentage of global pig meat consumption. Within China, pork accounts for 70 percent of meat consumption and is the preferred meat. Meat and fish are important elements of traditional diets, making demand rather unresponsive to changes in prices (inelastic), as consumers try to maintain their habitual consumption levels even at higher price levels.

Available estimates to assess the immediate effects of ASF on China’s pig meat output vary a lot, ranging from a decline of 20 percent to one of 70 percent. The Chinese authorities estimate a decline of 22 percent in 2019, while experts from the United States Department of Agriculture (USDA) estimate a 21 percent decline in 2019, followed by a further decrease of 10 percent in 2020 (USDA, 2019). These estimates were used to guide the reductions in the first scenario, at least for the period 2019-2021 (figure 1). The initial impact is assumed to diminish over time without, however, allowing production to fully return to the baseline path by 2030. In addition, the effects of a deeper impact in scenario 2 doubled the initial decline in production caused by ASF, i.e. a scenario where the decline reaches a level of 44 percent (figure 2). As the baseline already assumes a mild decline of about 6 percent, such a scenario would amount to a 50-percent decline in 2020/21 relative to an outcome without ASF. This scenario would reflect the assumptions made...
by Rabobank analysts, who assume roughly a 50-percent overall decline. A scenario with a 70-percent decline was deemed unwarranted under current circumstances.

**Other southeast Asia**

The importance of China’s swine sector dwarfs the combined effects for all other affected countries in the region. For instance, China’s production alone is about five times higher than the combined output in all other countries of the region. But the rest of the region is also different from China with regard to the likely ASF trajectories for their impacts over the medium term. Figure 3 illustrates the aggregate effects4 of ASF and the notably slow recovery path.

**Figure 3:**
ASF in southeast Asia, trajectory and protein gap – scenario 1 and 2

The comparison of the proliferation paths also suggests markedly different speeds of recovery. Many producers in the region, notably Viet Nam and Myanmar, still have only limited biosecurity capabilities, and much of the output stems from small-scale units, offering limited scope to compartmentalise production. Once affected, it will take longer for these countries to contain the disease and it will be harder to return to pre-outbreak production levels.

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4 The aggregate effects have been derived from the individual outbreaks as described in Annex 1, through aggregation into one single trajectory. It is important to note that the resulting trajectory reflects a bundle of country-specific disease paths. This aggregate never enters the model runs as such. Instead, all simulations are based on the country-specific trajectories, and the chart merely helps illustrate the overall assumptions made for the rest of the region.
Scenario 3: Global outbreak

The third scenario builds on the first scenario but assumes the outbreak to start in the hitherto unaffected countries as late as 2024. Combining the scenarios and their different assumptions on the extent and the speed of ASF proliferation renders the pork production paths depicted in Figure 5. On a global scale in figure 4, the impacts look much less dramatic, reflecting the fact that not all countries are assumed to be affected and that the recovery paths for countries with advanced, compartmentalised systems are assumed to be faster and less pronounced. The global impacts are critically important to understand and appreciate the results for global meat and feed markets produced by the Aglink/Cosimo modelling system.

**Figure 4:**
Pig meat production, global impacts – scenario 3

*Source: Authors.*

**Figure 5:**
Global pork production – all scenarios

*Source: Authors.*
The medium-term impacts

The results of the ASF counterfactuals

The protein markets

The outbreak of ASF has already left an immediate footprint on protein markets. It has created a supply gap for animal proteins destined for human consumption and, at the same time, a surplus of plant-based proteins destined for animal feed use. This holds for China and the world market at large. China’s supply gap arises from the fact that demand for animal protein in China is rather unresponsive to changes in prices and consumers strive to keep a constant level of overall intake of animal proteins, notably meats, fish and eggs. As neither domestic producers nor imports can adapt swiftly enough to fill consumer needs, a noticeable supply deficit for animal proteins (gap) emerges in the short term.

Over the medium term, this protein gap for human consumption can be closed by tapping into different supply channels. In principle, these include (i) importing pork, (ii) importing other meats, and (iii) increasing domestic meat production other than pork. In addition to meat, other sources of animal protein destined for human consumption can be used to close the protein gap, including cheese or dairy products, such as whole milk and skim milk powder.

Filling the pork protein gap, its impacts on production and trade

The model-based results suggest that the largest part of the animal protein gap created by ASF will be filled over the near to medium term, almost regardless of the scenario and the size of the protein gap. The sources contributing to filling the gap are summarised in Figure 6. They apply to Scenario 2 and reflect 2021. To ensure comparability and additivity, all products have been converted into grams of protein available per person per day.

The protein gap will largely be filled after an initial adjustment period of about three years. This happens in all scenarios, and is facilitated either through higher imports of meat, higher domestic production of meats other than pork, or increases in production and imports of eggs and dairy products. The only significant unfilled gap occurs in the first two years of the ASF outbreak, that is, in 2019 and 2020.

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5 Where available, there is an option to tap into pork reserves, the supplies of which are usually limited; in China, releasing strategic pork reserves kept prices in check in 2019.

6 Whey powder, by contrast, is mainly used to rear piglets and pigs. Imports and domestic use are expected to decline, similar to plant-based proteins.

7 The contributors to closing the pork protein gap include poultry and waterfowl, beef, sheep and goat meat as well as eggs. Eggs are a particularly important element of animal protein supplies in China, accounting for some 15 percent of total animal protein intake and 6 percent of total protein. Not included in the model runs are higher production and consumption levels for fish and seafood, which would not come in addition to the higher levels of production and import but rather supplement them.
The near closure of the protein gap is at variance with what has been observed so far. It also differs from the expectations of many market observers. Analysts from the Rabobank (2019b), for instance, expect that much of the 2019 protein gap will remain unfilled, leaving a large protein deficit relative to the baseline and an even larger one relative to the pre-ASF period. USDA analysts, by contrast, expect the protein gap to be filled to a more significant extent, albeit their basic assumption is a more moderate reduction in pork production than that assumed in Scenario 2.

There is rationale to support either outcome, that is, to assume that the protein gap will be filled, or will remain open. Arguments supporting the closure of the protein gap include the low responsiveness of demand to changes in meat prices and the high levels of per capita incomes already attained in urban areas in China. China’s cities also have the requisite marketing infrastructure as well as the economic power to purchase more meat and other forms of animal protein. Metropolitan areas in the east are close to international markets and well-connected to them. Internally, there is the possibility to step up production, notably for poultry meat and eggs, and given the rather short production cycles for these products, a high domestic supply response appears plausible, even if it would require the building of new production facilities, which would come with their own environmental problems and would have to clear administrative hurdles.

Arguments supporting an outcome where a large part of the protein gap will remain unfilled include the lack of physical infrastructure to support a sizeable increase in imports to China. Channelling up to 7 million tonnes of additional meat into China’s ports and from there into its cities or even its hinterland would entail

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**Source:** Authors.

**Figure 6:**

Fast and near closure of the pork protein gap

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8 USDA (2019) GAIN report CH19035 states: “Despite an anticipated 21-percent herd reduction in 2019, it is likely there will be sufficient animal protein supplies to meet Chinese demand. Shrinking Chinese pork consumption, increased imports, rising consumption of other animal proteins (primarily poultry), and above-average frozen pork stocks (estimated at 3-5 million metric tons, or MMT) will balance the estimated 6 MMT drop in pork production and moderate the rise of pork prices. As pork supplies tighten through the second half of 2019 and demand strengthens near the Chinese New Year in January 2020, pork and all other animal protein prices will rise and imports will increase”.

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significant investments in discharge and transportation facilities to handle frozen products and would require the development of gapless cold chains with facilities for intermittent storage, handling, marketing and processing. It would also require a comprehensive upgrade to sanitary control capacities (food safety inspection, etc).\(^9\) Prohibiting swill feeding would require an alternate feed system and infrastructure to process food waste throughout the system, particularly in remote areas. Likewise, not all exporters may be fully prepared to step-up shipments to China at the volumes needed to close the protein gaps. They, too, may lack the physical export infrastructure, the shipment facilities and the food inspection capacities to facilitate trade without jeopardising food safety and/or domestic food supplies. Finally, the investments to expand and upgrade the import infrastructure may present considerable sunk costs on both sides of the trade at a later stage, that is, once ASF is under control, which is expected for the end of the outlook period.

These factors suggest that the projected closure of the protein gap represents an extreme outcome, driven by the economics written into the model, which may not fully capture the boundary conditions arising from exogenous constraints such as infrastructure or sanitary control capacities.

Who takes advantage: foreign or domestic suppliers?

In addition to whether and what extent the protein gap will be filled, the questions arise as to how and by whom the gap will be closed. Who is able to reap the market shares that will become available as ASF spreads within and beyond southeast Asia? Are these new opportunities reaped by domestic producers or by foreign suppliers, shipping larger quantities to the ASF-affected areas in China and southeast Asia at large? Given the importance of China as the single largest protein market globally, the focus in describing the results will be on China.

The key results addressing these questions are depicted in Figures 7a/b and 8a/b. As illustrated in figure 6, the rise in domestic pork prices in China due to the supply shortages reduces domestic demand by up to 22 percent (2020 in scenario 2). This gap is partially filled with other meats, such that the reduction in total meat consumption is only about 10 percent in the peak year (2020 in scenario 2, lower in other scenarios). Three major sources are available to supply China’s market: imports of pork, domestic increase in alternative meat production (poultry, beef and sheep) and higher imports of these meats. The relative shares of these supplies differ between scenarios and over time. In the “deep impact” Scenario 2, almost 80 percent of the gap is filled by imported pork, while the remainder comes from other types of domestically produced meat. Apparently, both domestic producers and foreign suppliers can increase their supplies, but large commodity-specific differences across the different sources of animal protein remain. As far as the meats are concerned, foreign suppliers can capture the lion’s share of the protein gap created by lower domestic pork production. This is one of the obvious conclusions when comparing charts 7a/b and 8a/b. They will capture 75 percent of the meat gap, compared to 25 percent captured by domestic producers. Practically all of the foreign supplies will be pork, while domestic producers will capture some of the meat market by stepping up poultry meat, sheep and beef production.

These results hold mainly, but not only for Scenarios 1 and 2, which are the scenarios where the proliferation of ASF remains limited to southeast Asia. In the case of an outbreak that is less geographically contained, as assumed in Scenario 3 where a new wave of ASF cases arises in 2024, foreign suppliers will obviously

\(^9\) Tripoli and Schmidhuber (2020) suggest that there is a growing set of new technological options that would support a rapid and effective upgrade in sanitary capacities and capabilities.
have less to export to China and southeast Asia at large. More generally, ASF will limit the amounts of meat available on global markets, notably for pork. As a result, even a rather inelastic buyer like China will see a sharp drop in import growth compared to the baseline, reacting to much higher import prices. Figure 8b illustrates the impacts in the case of a wider spread of ASF. It is only under these circumstances that a more significant part of the pork protein gap will remain unfilled. In Scenario 3, the “global impact” scenario, the situation is almost reversed. Depending on the year, pork imports cover only about 40 percent of demand, while the domestic production of other meats can supply up to 75 percent of the diverted demand.

Figure 7a: Change in meat production – ASF scenario 2 (protein equivalent)

Figure 7b: Change in meat production – ASF scenario 3 (protein equivalent)

Figure 8a: Change in meat imports – ASF scenario 2 (protein equivalent)

Figure 8b: Change in meat imports – ASF scenario 3 (protein equivalent)
Large differences across different sources of animal protein

The question of who benefits is closely related to the question of what proteins will help fill the gap left by ASF. In all scenarios, pork will see the largest gain in terms of import supplies to China. This is largely consistent with the hypothesis that pork is the preferred meat and that demand is inelastic as Chinese consumers will stick to their traditional dishes and consumption habits. By contrast, net imports of poultry meat could even see a slight decline, owing to a strong rise in domestic poultry production in conjunction with the sharp increase in import prices. The principal effects under Scenario 1 are similar to those of Scenario 2, except that the extent of the protein gap under the former is much smaller and therefore the effects on imports and production are less pronounced.

While pork imports are the main contributor to filling the meat gap, domestic egg producers reap a large share of the broader animal protein gap. They see a rise in production of almost 4 million tonnes or 12 percent relative to baseline levels of production. They benefit from lower tradability of the product and their ability to quickly expand production. Overall, they will cover as much as 39 percent of the reduction in domestic pork protein production in the early years and will decline over time as meat production recovers.

Figure 9:
Egg production – China

Source: Authors.

The principal commodity effects under Scenario 3 are largely the same as under Scenario 2. They differ mainly insofar as fewer sources of imports are left to supply China’s meat market once ASF has become endemic in all of Europe and most countries of the Americas. As ASF spreads, it will slow the reduction of net pork imports and keep overall net imports above baseline levels. Under this scenario, the effects on imports of both poultry and ruminant meats will be more muted, and will be above or below baseline levels over time (figure 10). The production of domestic meat will cover more of the domestic demand, and the compensatory share of eggs will be only around 35 percent at the peak.
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**Figure 10a:**
Net trade of poultry meat – China

**Figure 10b:**
Net trade of ruminant meat – China (beef and ovine)

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**Impacts on world market prices**

The rapid and robust supply response in the global pork market is supported and indeed explained by a significant reaction in prices. Under the assumptions of Scenario 2, the Pacific pork price, which is the world indicator price for pork, sees an increase of 68 percent (2020) over baseline levels (figure 11). Pork producers not only benefit from higher pig meat prices, they also stand to gain from lower feed prices, notably lower prices for protein meals and to a lesser extent lower feed grain prices. The combination of higher output prices and lower input prices boosts their gross margins and makes pork producers the single most important beneficiary of a regional spread of ASF. What is more, the large size of the southeast Asian meat market and the long time it takes to contain the disease suggest that these benefits will last for many years to come, with prices remaining consistently above levels that would prevail otherwise, that is, the baseline levels. If ASF spreads further into Europe and the Americas as assumed in Scenario 3, the main long-term beneficiaries will be fewer, mainly the few areas that are likely to remain ASF-free (e.g. Australia and New Zealand). Also, the producers of other meats stand to benefit from lower feed and higher meat prices, but obviously to a lesser extent than pork producers.

The impacts on profitability for individual producers are not necessarily the same as those for the whole agricultural sector, that is, the micro-level results differ from the macro-level results. From a macro perspective, the main beneficiaries are those countries that import feeds and export meats and more generally, those that import plant-based proteins and export animal-based proteins. The latter holds for many countries in Europe that have developed a pig and poultry meat sector that converts imported protein meal into exports of meats and milk products. These country and product-specific impacts can be further analysed by taking a closer look at the impacts on feed markets.
Figure 11:
Price impacts (all 3 scenarios)

Source: Authors.
Feed markets

Much of the effect on feed markets depends on the extent and the speed by which the pork protein gap caused by the spread of ASF will be filled. As already discussed, the Aglink/Cosimo model assumes a fast and near complete closure of the protein gap. The gap is filled either by higher production of eggs and non-pork meats in China and southeast Asia or by imports of pork to the region from international markets.

With a fast filling of the protein gap, changes in the protein meal market are mainly the net effect of a shift between different types of animal protein and between different animal protein producers. A number of factors are at play in determining the amounts of grain and protein meals needed under a given ASF trajectory. One is the composition of the overall livestock herd, for example a shift from pork to poultry or to beef and sheep production. In general, ruminant meat production is less compound feed intensive and would therefore require less feed grain and oil meals to produce a given amount of animal protein. This effect can be thought of as one that comes from different feed intensity rates. The changes in intensity rates also apply to a shift within a given form of meat production. For instance, a shift in pork production from backyard production to industrialised production would increase the use of compound and concentrate feeds in a similar way as a shift across different sources of meat production. Secondly, there is a shift that arises from livestock sectors with different efficiency rates within the same type of meat or animal protein. For instance, a shift from less developed pork production systems, such as those characteristic of Viet Nam or Myanmar, to more advanced systems such as those of Europe or the Americas will not only increase intensity rates, but also improve efficiency rates, that is, the amounts of concentrate feed needed for a unit of animal protein at a given intensity rate. Such shifts in efficiency can indeed offset shifts to systems with higher intensity rates. Lastly, the overall responsiveness of the animal production system plays a role, as different closing rates of the protein gap would obviously result in different needs for feed grain and meal requirements.

These shifts are captured by the mechanics of the results. When production is reallocated between producing countries and products, different efficiency and intensity rates apply and change the requirements for a given amount of animal protein. But these effects are only captured in a static manner, that is within a given structure and within the assumed trajectory of structural change. The structural changes likely to be induced by an ASF outbreak and the dynamic change in feed requirements resulting from the added structural change are not captured.

Against this backdrop, the resulting effects for feed use predicted by the model are rather limited. Not only is the animal protein gap small, the effects that arise from a shift in products and producing countries largely offset each other globally and do not significantly affect the amounts of feeds required and the prices to be paid. This holds both for grains and protein meals. In the aggregate, both prices for feeds and quantities used only decline relatively modestly.
Figure 12: Soybean imports by origin and month – China

These results appear to be at odds with the short-term reactions observed in 2018/19, which saw a reduction in soybean imports of more than 10 percent. At the same time, the observed short-term decline in imports need to be seen as the result of a confluence of different factors, not only the effect of ASF. Arguably the most important factor, other than the ASF outbreak, was the looming United States of America-China trade conflict. Over the course of the trade dispute with the United States of America, China imposed a 25-percent tariff on soybean imports from the United States of America and started to source a growing amount of its soybean imports from Latin American suppliers. The monthly import volumes depicted in Figure 11 illustrate this shift. From August to December 2018, monthly imports declined from more than 8 million tonnes to less than 6 million tonnes. At the same time, China shifted its import source from the United States of America to Brazil and Argentina, as well as countries subsumed in the Rest of World (RoW) aggregate in Figure 12 (Schmidhuber, 2019b).

### A structural shift in oilseed and oil meal imports?

While China reduced its soybean imports in the short term, it may not choose to do so over the medium term. The model results show a moderate reduction in soybean imports by China, even in Scenario 2, that is, in the case of a sharp drop in pork output. Instead, it predicts that China continues to import oilseeds (Figure 13a), crushes them domestically and exports the excess meal that is not absorbed by the livestock sector onto the world market (Figure 13b). The rationale behind that outcome includes a number of factors. First, that the ASF outbreak will not change China’s need for vegetable oils, which requires the country to import oilseeds, crush them, retain the oil and re-export the meals (Figure 13b). Second, importing oilseeds and exporting excess meals allows the industry to keep capacity utilisation high and unit crush costs low, supporting the competitiveness of an industry that is otherwise known for low crush margins. And finally, importing large amounts of soybeans and exporting excess soymeal could also be the result of the settlement of the United States of America-China trade conflict, that is, a scenario where China continues to import soybeans from the United States of America, even if the full amount of soybean protein cannot be absorbed by the domestic livestock industry.

**Figure 13a:** Other oilseeds net trade – China

**Figure 13b:** Protein meal net trade – China

*Crush margins in China have been under pressure, owing to overcapacity and higher unit costs with lower imports in 2018 and 2019.*

Source: Authors.
Beyond ASF

The recent slowdown in soybean imports also needs to be seen against the backdrop of a broader change in China’s livestock industry. The slowdown started years before the ASF outbreak and there are reasons to assume that it would have continued even without ASF, albeit in a less pronounced manner. A number of factors have contributed to the slowdown. First, there has been a growing saturation of China’s overall meat market. Per capita meat consumption levels have reached rather high levels of about 55 kg per year, which includes beef, chicken, pork, sheep and goat meat. If farmed fish and eggs are added, per capita consumption levels reach nearly 100 kg per year, which is similar to levels that have ushered in a slowdown in other countries. As a result of slower growth in demand for and production of animal products, feed requirements have risen less rapidly. Second, feed operations have increasingly attained high intensity rates (high shares of compound and concentrate feeds) and reasonably high efficiency rates, leaving less room to add grains and oil meals to the rations. For example, intensity rates for poultry production are estimated to have reached 90 percent, and those for pig production 85 percent, that is, levels on par with those of advanced (industrialized) feeding systems. Third, soybean feed use and imports slowed after China embarked on price reforms in its maize sector in 2016. Prior to these, the elevated maize prices attracted not only imports of barley and sorghum but also boosted demand for soybean meal. In effect, relatively inexpensive soybeans have not only supplemented maize, but have also replaced some of the energy provided by maize and other feed grains. With lower maize prices, soybeans became relatively expensive and imports slowed (Schmidhuber, 2019a).

The broader feed market

Other protein meals

While China’s pork protein gap is largely being filled, the protein gaps in other countries in southeast Asia remain largely open. Lower protein demand creates downward pressure on the world price for protein meals (Figure 13).

Figure 14:
Protein meal price – World

Source: Authors.
The high substitutability between the various meals suggests that all meals will be affected equally. The price effects on the underlying seeds depend on their respective oil content and may not change much when the oil share is high relative to the meal share (e.g. for rapeseed and sunflower).

**Other feed grains**

Just like for the protein meals, there is a high substitutability between feed grains which means that grains like barley and sorghum will be more affected in relative terms than the larger maize market. With ample internal supplies of maize in conjunction with lower overall feed demand due to the outbreak of ASF, imports of barley and sorghum have already been affected. Over 2018-2019, they declined to a fraction of the volumes imported in previous years. Other factors played a role in the decline as well, particularly for sorghum imports. With high tariffs imposed on supplies from the United States of America in August 2018, sorghum imports have come to a near complete halt. Barley imports have also remained at low levels (Figure 14).

**Figure 14:** Sorghum imports by month – China

Ramifications beyond the meat and feed markets

The market for vegetable oils

The adverse demand impact on other oilseeds has ramifications for the vegetable oil markets. Crushing fewer oilseeds, such as sunflower and rapeseed, leaves less supply in the vegetable oil market and supports prices for vegetable oils. These oilseeds also have a higher oil content than soybeans, and lower crush rates will result in a decline in overall supplies of vegetable oils. At the height of an assumed ASF outbreak and assuming the trajectory of Scenario 2, vegetable oil prices would be 5 percent higher than the baseline.

Ethanol

Dried distiller’s grain with solubles (DDGS) is an important by-product of ethanol production. DDGS is a protein-rich feed and, while richer in crude fibre, is a good substitute for protein meals “at the margin” of additional use. With lower prices for protein meals, DDGS prices will come under downward pressure and so will margins for ethanol producers.

Heparin production for human use

Pigs are not only a major source of food and protein supplies, they also serve as a reservoir of ingredients for the pharmaceutical industry. For instance, the active ingredient in heparin, an anti-clotting drug, is derived from pig intestines. Heparin is a critical drug for heart attack patients and is used during surgeries to stop clots. Much of the world’s supply of the active pharmaceutical ingredient, or API, for the blood thinner comes from China, and is a byproduct of the nation’s massive consumption of pork (Edney, 2019).

While the pharmaceutical industry is sourcing the raw materials for heparin from multiple suppliers and geographical regions, the size of China’s pig market could trigger API supply constraints globally for as long as the ASF problems last. There are also concerns that the current shortage of API may cause increased sourcing from less reliable suppliers, as was the case in 2008, when tainted raw materials for heparin made their way into the international drug supply chain. Then, the contamination resulted in the deaths of more than 200 patients. Current shortages are feared to result in similar sourcing behaviors that would persist for many years, again putting patients at risk (Edney, 2019).

Structural change

The current ASF crisis may not only pose a challenge, it may also create an opportunity over the medium term. Containing and controlling ASF will require a bundle of different measures in the short term, notably an improved monitoring and surveillance system. Containing and controlling ASF over the medium term will necessitate more than just improved monitoring, it will require improved biosecurity measures, above all a compartmentalised production system with larger, vertically integrated units. Such structures will not only improve the biosecurity situation, they can also help reduce the unit costs of production, by offering lower fixed costs and improved feeding efficiency. With larger and more efficient structures, China will not only be less dependent on pig meat imports, its consumers may also enjoy lower meat prices. At the same time, structural change may mean that most backyard producers, who are less biosecure and less economically efficient in producing pig meat, will disappear, potentially adding to rural poverty and rural-urban migration problems.
Conclusions

The ASF outbreak in China is affecting regional and global meat and feed markets with potential impacts on vegetable oils, biofuels and even pharmaceuticals. The simulation results show a range of possible effects for agricultural commodity markets, notably a large initial protein gap. The Aglink/Cosimo model assumes that this protein gap will be filled rapidly and almost completely by both a higher production of eggs and non-pork meats (chicken, beef and sheep/goat) in China and by pork imports from international markets. The discussion of the results also suggests that there are plausible reasons for a fast and near complete closure of the protein gap, notably the high income levels in China and the low responsiveness of Chinese consumers to higher protein prices. But there would also be good reasons to assume that a sizeable share of the protein gap will remain unfilled, including the lack of the necessary import infrastructure for meat, with gapless cold chains and efficient and comprehensive sanitary controls. Not filling the protein gap would also leave domestic meat prices at high levels, which would translate into higher overall inflation rates, at least initially.

The simulations further suggest that an ASF pandemic would drive a lasting wedge between plant protein and animal protein prices, both locally and internationally. Oil meal prices will be particularly adversely affected, whereas pork and poultry prices will see a significant price rise. Countries that import the former and export the latter—in particular Canada and countries in Western Europe—are likely to become the main beneficiaries of the ASF pandemic, benefitting from lower input prices and higher output prices for potentially large volumes of exports. The paper also suggests that the current crisis could become an opportunity for China over the medium term, particularly if it triggers a shift to a more biosecure production system, which may not only be more resilient to diseases but also more economically competitive.

The results are important for decision makers in both the private and public sectors. Farmers outside of China are afforded a significant and rare growth opportunity. In particular, pig and poultry producers will see their gross margins rise for a number of years. Nevertheless, the ASF outbreak could also lead to more competitive meat production systems in China, eventually lowering high initial gross margins in exporting countries. In the public sector, policy makers will be confronted with the growing need to promote more biosecure production and trading systems without erecting new, unjustified trade barriers. The fast spread of ASF and the global impacts at the international level also suggest a growing role for the providers of global public goods, such as FAO. It underlines the need for an effective monitoring and early warning system, such as the FAO EMPRES and FAO Global Information and Early Warning System (GIEWS). In addition, it highlights the need for strong animal traceability systems with integrated communication flows and data sharing between producers and national authorities, which can be achieved with digital technologies (Tripoli & Schmidhuber, 2020). Similarly, it underlines the importance of globally accepted biosecurity and food safety standards such as those enshrined in the World Organisation for Animal Health’s (OIE) standards and guidelines in the Terrestrial Animal Health Code and the FAO/WHO Codex Alimentarius.
References


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Annex

Scenario 1:
Key assumptions and trajectories

Least developed countries of Asia

Philippines

Thailand

Viet Nam

South Korea

ASF in China – scenario 1

Source: Authors.
Scenario 2: Key assumptions and trajectories

ASF in China, deep impact scenario, trajectory and protein gap

Source: Authors.

Scenario 3: Key assumptions and trajectories

Pig meat production: global impacts – scenario 3

Source: Authors.