Meat consumption and production in developing countries: who bucks the trend?

An agenda for animal advocacy researchers

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Executive Summary

The next few decades represent a looming catastrophe for farmed animals. The production of meat and animal products is projected to expand substantially. This growth is expected to be highest for animals who typically experience the poorest welfare conditions on farms (such as chickens, fish, and crustaceans). Furthermore, farming is likely to become more intensive. All of these factors mean that significantly more animals will experience severe suffering for the sake of the production of meat and animal products.

A key driver of this growth is the expansion of intensive animal agriculture in low and lower-middle income countries. As a country's agriculture industry expands, the number of animals farmed in intensive conditions in that country depends on two key factors: per-capita meat consumption (consumption) and the level of industrialisation in meat production systems (production). Both of these key factors follow average trends relating to demographics. Generally, as countries become wealthier, per-capita meat consumption tends to increase, and the meat production system becomes more industrialised.

Critically, there is variation in trends of meat consumption and meat production across different developing countries. Some countries have much lower per-capita meat consumption than other countries with similar levels of wealth, and some countries have become wealthier without a significant increase in per-capita meat consumption. On the production side, some countries exhibit much lower levels of intensification compared to other countries with similar levels of wealth. This suggests that countries can achieve economic growth while minimising harms to animals.

Why does this variation exist? When countries have low per-capita consumption, rates of per-capita consumption that are not increasing, or low levels of intensification, is this because the country has pursued certain policies? If so, what are these policies - and can they be replicated in other countries? Identifying these policies could unlock strategies to prevent large numbers of animals being farmed in abhorrent conditions while developing countries experience economic growth. Alternatively, it is possible that these trends are influenced by factors other than policies, which may not be replicable in other countries.

This report is aimed at animal advocacy *researchers*. In particular, this report is intended for researchers who are interested in exploring whether there are particular policies that can influence meat consumption and production as countries develop. We do not make any specific policy recommendations in this report, as the research is still at an early stage. However, we believe that building on this research will indeed uncover impactful policy recommendations in the future.

In this report, we seek to provide a foundation on which other researchers can build and identify promising directions for further research. We have obtained datasets that can be used to identify these outlying countries. For the consumption side, initial exploration of individual countries has taken place, and potential research directions that the movement could pursue are identified. Regarding the production side, data availability has limited our analysis, so we have identified opportunities for the movement to improve the available data.

If you are a researcher interested in slowing the growth of industrial animal agriculture in developing countries, we think the most promising research directions are as follows:

- For consumption, we identified two countries with steady or declining meat and fish consumption: Slovakia and Thailand. It is possible that these steady/declining trends are due to policies that can be replicated in other countries. So, it could be worthwhile for the movement to investigate these two countries in greater depth.
- For consumption, we identified nine countries with low *baseline* consumption (rather than a steady/declining *trend* in consumption): Botswana, Nigeria, Sri Lanka, North Macedonia, Bosnia and Herzegovina, Georgia, Azerbaijan, Eswatini, and India. It could also be worthwhile to investigate the reasons for this low consumption.
- For production, we have identified a dataset (1) that could be useful for figuring out why some countries adopt intensive animal production systems while others do not. But the dataset is incomplete. Spending some time developing this dataset would enable the movement to start investigating which countries have lower-than-expected levels of intensification, and whether this is due to any particular policies that could be replicated in other countries.

- For both consumption and production, comparing different regions *within* a country could also be a promising research direction. This could also identify policies that explain differences in meat consumption or industrialisation between regions. Due to time constraints, we have only focused on comparing differences *across* countries.

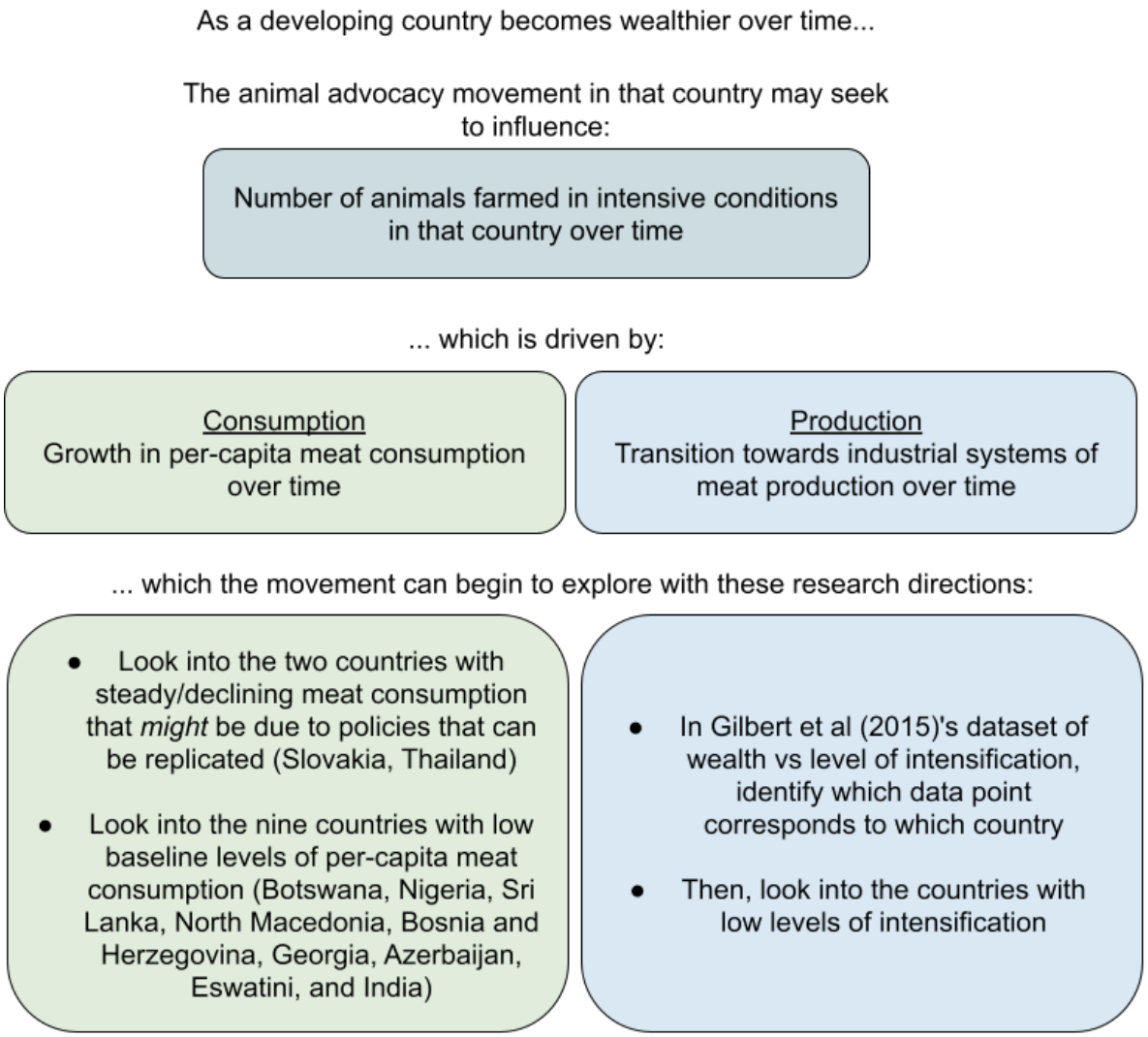

Figure 1: Summary of our conceptual approach and results.

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1. Introduction

Animal agriculture in developing countries

Unless policies change, the next few decades represent a catastrophe for farmed animals. Consumption of meat and animal products is projected to increase substantially over the coming decades, with one study projecting a global increase of 38% between 2020 and 2050 (2). For the consumption of animal products to grow by this magnitude over the next three decades, many more animals will suffer and die to meet this demand - in fact, since the growth will be dominated by small-bodied animals like fish, crustaceans, and chickens, the number of *individual* animals farmed is likely to increase by much more than 38% (3). These are also the groups of animals who, generally speaking, experience the worst welfare conditions out of all farmed animals and require the most suffering per unit of food (8–11). Moreover, the catastrophe could be compounded by the growing insect farming industry, which will likely involve farming trillions of insects - who, the evidence strongly suggests, have the capacity to feel pain (12) - to provide feed for the farming of poultry, fish, pigs, and other animals (13).

The growth will be highest in low and lower-middle income countries (2,3). For example, the share of global meat consumption in Sub-Saharan Africa will probably at least double by 2100, and a quadrupling of its global share seems possible (4). This growth will likely be

supported by the intensification of agriculture - more animals will be produced, and they will be farmed under more intensive conditions. By intensive animal farming, we mean the system of commercial animal farming that involves large-scale, indoor facilities, where animals are 'confined indoors under strictly-controlled conditions' (5). The definition is slightly different for fish and crustaceans, for whom intensive farming refers to systems with high stocking densities and high levels of input and management (e.g. feed); these systems are associated with numerous welfare problems (6,7). There are signs that intensive animal agriculture is politically well-supported and becoming more common in Sub-Saharan Africa (4). The growth will be highest for fish, crustaceans, and chickens (3). These are the groups of animals who, generally speaking, experience the worst welfare conditions out of all farmed animals and require the most suffering per unit of food

We cannot overstate the severity of the crisis unfolding before us and the urgency with which the animal advocacy movement must meet this challenge. The way that farmed animals are treated by humanity is already a catastrophe - trillions of animals routinely suffer and die under abhorrent conditions. Furthermore, since agriculture is projected to become more intensive, it is likely that the suffering experienced by the average individual animal will become more severe. The growth in consumption will be highest for the very species who already experience the most suffering (fish, crustaceans, and poultry). Moreover, the catastrophe could be compounded by the growing insect farming industry, which will likely involve farming trillions of insects - who, the evidence strongly suggests, have the capacity to feel pain (12) - to provide feed for the farming of poultry, fish, pigs, and other animals (13).

The growth will be highest in low and lower-middle income countries (2,3). For example, the share of global meat consumption in Sub-Saharan Africa will probably at least double by 2100, and a quadrupling of its global share seems possible (4). This growth will likely be supported by the intensification of agriculture - more animals will be produced, and they will be farmed under more intensive conditions. By intensive animal farming, we mean the system of commercial animal farming that involves large-scale, indoor facilities, where animals are 'confined indoors under strictly-controlled conditions' (5). The definition is slightly different for fish and crustaceans, for whom intensive farming refers to systems with high stocking densities and high levels of input and management (e.g. feed); these systems are associated with numerous welfare problems (6,7). There are signs that intensive animal agriculture is politically well-supported and becoming more common in Sub-Saharan Africa (4).

Campaigns to oppose industrialisation have been gaining initial attention and consideration in the animal advocacy movement (4,14,15). For example, mitigating the growth of industrialised farming in Africa was a key resolution from the 6th Africa Animal Welfare

Conference in Gaborone, Botswana in 2022. Still, It is unknown whether it is possible for advocates in developing countries to limit the intensification of animal agriculture (4,15); expert opinions are divided (15).

Likewise, if there are ways to limit the consumption of meat and animal products, then this could cause fewer animals to be farmed for food. Since the scale of animal production in developing countries is projected to grow substantially, succeeding in either of these areas could affect a disproportionately large number of animals. As such, influencing the trajectory of animal farming in developing countries is a major opportunity for improving the lives of animals. This is a critical knowledge gap for the animal advocacy movement. The goal of this report is to help advance the research into this question.

Key sources on influencing farmed animal welfare in developing countries

Existing research on influencing the intensification of animal farming in developing countries is relatively limited. A few key sources are as follows:

- Delgado et al. (17), motivated by disease risks and environmental challenges, analyse what determines the scale of production in animal farming in four developing countries. The authors conclude that many smallholders could remain economically viable for a long time, and the authors suggest ways to promote small-scale farming.
- Schneider (18) describes the concept of the 'meat grab', which involves land deals undertaken to allow industrial meat production. These land deals can be direct (e.g. animal housing and stocking) or indirect (e.g. feed crop production). Schneider argues that the spread of industrial livestock production is driven by 'agribusiness-led and state-brokered industrial meat regimes' that involve land grabbing, hiding externalised costs, and promoting narratives that link meat consumption with progress.
- Von Keyserlingk and Hötzel (19) discuss how studying intensive animal farming practices can generate insights for addressing animal welfare in developing countries. The authors provide a roadmap on how animal welfare could be addressed in developing countries, and they call for tailored, culturally relevant, and science-based solutions for animal welfare reform.
- Lam et al. (20) examine the expansion of industrial animal farming in 10 low- and middle-income countries. This study shows that domestic policies - such as the government's objectives and the practices that are encouraged - are an important factor in the industrialisation of animal farming.
- Gbejewoh et al. (21) explore one potential avenue to influencing animal production in sub-Saharan Africa: plant-based meats. The authors call for further research on the health effects of plant-based meats, as well as consumer research on the socio-cultural connotations and barriers to adoption in Africa.

These key sources provide the foundation for understanding the intensification of animal farming in developing countries.

To build on this foundation, it would be valuable to examine the factors that determine whether, and how, this intensification of animal farming occurs as countries develop. As far as we know, there has not yet been a major, global-scale analysis on this question. Do all countries necessarily develop an intensified animal farming sector, or is it possible for animal farming to remain extensive and small-scale? Are there policies that can meaningfully limit the number of animals living in intensive agriculture as a country develops? If so, what are these policies? In this report, we hope to begin this line of thinking and begin some research directions for the animal advocacy movement to pursue.

2. Our Approach for Analysing Trends of Meat Production and Consumption

As discussed above, intensive animal agriculture is particularly harmful for animal welfare. In this report, we aim to uncover whether there are any ways to limit the number of animals living in intensive animal agriculture as a country develops. To answer this question, we need to analyse how the number of animals living in intensive animal agriculture changes as a country develops.

The number of animals living in intensive agriculture in a country depends on two major factors, one relating to consumption and one to production:

1. (Consumption) The demand for meat in that country, which can be expressed as the meat consumed per person. If the people in a country eat more meat, then there will be higher demand for meat, which would translate to more animals being farmed and killed. This factor can be measured using the metric *meat consumption per capita*, which is the average amount of meat consumed per person in a country.
2. (Production) The level of intensification in animal agriculture in that country. If the farms in a country are more intensive, then a higher proportion of animals will live and die under intensive conditions. This factor can be measured using the metric *proportion of intensive animal production*, which is the fraction of animal farming operations in a country that use intensive (rather than extensive) production systems.

As a country develops, those two major factors also evolve in a predictable way. It is well-established that, on average, as a country becomes wealthier, meat demand per person increases. Likewise, on average, as a country becomes wealthier, animal agriculture transitions from mostly extensive to mostly intensive. We review the evidence supporting these two trends below.

Critically, these trends hold on average, but not necessarily for every country individually. Averages can obscure useful information. For both of these trends, some countries are outliers.

It may be the case that, on average, people in wealthier countries consume more meat, but are there individual countries that have become more wealthy while keeping per-person meat consumption steady? Wealthier countries tend to transition towards intensive agriculture, but are there individual countries that have not done so? And if there are individual countries that do not follow these trends - in other words, if some countries have lower meat consumption or a lower proportion of intensive agriculture than would be expected - is the reason that these countries have pursued policies that could be replicated in other countries? These questions are our focus in this report.

Note that, for our analysis of consumption, we focus on meat and fish and we refer to the total weight of animal products consumed. Ideally, an analysis would include all animal products (especially eggs) and convert the weights of meat, fish, and animal products into 'number of animals slaughtered per capita' or 'number of animals alive at any one time'. This would require some tricky calculations and assumptions - it would be a fruitful endeavour for the next study on this topic, but our current study is just a first look. Sans and Combris (22) (discussed below) found that meat is the most important of the four, though it's still possible for fish, eggs, or milk to increase over time even where meat doesn't.

3. Consumption: How Does Meat Consumption Change as Countries Develop?

This section of the report will focus on the first of the two major drivers: the consumption of meat per capita.

Wealthier countries eat more meat, but there is variation

It is well-established that meat consumption per capita and wealth are strongly correlated. As countries grow richer, the average meat consumption of the people living in those countries tends to increase.

Milford et al (23) analysed the factors that explain the meat consumption per capita observed across countries. The authors identify a number of drivers of meat consumption per capita, which they divide into four categories:

- Economic factors, like income per capita. As people in a country become wealthier, they tend to eat more food per capita ('expansion effect') and then shift away from

carbohydrate-rich staples like cereals, roots and tubers towards vegetable oils, sugars, and animal products ('substitution effect').

- Natural endowment factors, like land availability and a climate suited to animal agriculture.
- Social factors. One key factor is urbanisation: people in cities tend to eat away from home and prefer pre-cooked convenience foods. Cities also bring supermarkets, transportation systems, and mass media that may advertise globalised trends, like Western animal-based diets. Social factors also include female participation in the workforce and religious views, for example.
- Globalisation factors. There is no consensus on the relationship between globalisation and diet.

The authors found that the two most important drivers of meat consumption per capita are income per capita and urbanisation.

Critically, not every country follows a positive relationship between meat consumption per capita and wealth. Although there is a positive relationship between meat consumption per capita and wealth on average, there are individual countries where meat consumption per capita has not grown even as the country becomes richer.

Sans and Combris (22) analysed trends of meat consumption for 1961-2011 for 183 countries. The authors also analysed fish, dairy, and egg consumption. The authors find that the consumption of meat and these other animal-based proteins is positively correlated with both GDP per capita and urbanisation. Most of the increase in animal-based protein consumption over time is explained by growth in meat consumption, rather than the consumption of fish, dairy, or eggs.

But crucially, the authors point out that periods of economic growth are not always accompanied by growth in consumption of meat and other animal-based proteins: Argentina experienced economic growth, but meat protein consumption fell significantly (−8 g meat protein /person/day). For China and Spain, the periods where meat consumption grew the most were not the periods where economic growth was highest. The authors discuss the importance of cultural and religious factors in explaining different trends in meat consumption across countries.

Whitton et al (24) analysed trends of meat consumption for 2000-2019 for 35 countries monitored by the Food and Agriculture Organization and the Organisation for Economic Co-operation and Development. The authors identified two types of countries: countries in which GDP per capita is correlated with meat consumption, and countries in which there is

no such correlation. There were nine countries (all highly wealthy) where GDP per capita was unrelated to meat consumption: Switzerland, Norway, the USA, Australia, Canada, Israel, the UK, New Zealand, and Saudi Arabia. In fact, for some of these countries (New Zealand, Canada, Switzerland), meat consumption appears to be decreasing. The authors believe that this is because many people in these wealthy countries are consciously reducing their meat consumption, motivated by concerns for the environment, health, and animal welfare, as well as higher availability of alternative proteins. This finding is less relevant for our report - while decreasing meat consumption in wealthy countries is a good thing, here we are most interested in the short- and medium-term future of animal farming in developing countries.

This body of literature shows that there is a positive relationship between GDP per capita and meat consumption per capita. However, there seem to be some individual exceptions - not every country follows this relationship, so there are some countries where GDP per capita increases but meat consumption per capita does not.

We seek to a) identify countries where meat consumption per capita has not grown, even as the country develops, and b) see if those countries have any policies causing meat consumption per capita not to grow. If we can identify any such policies, those policies could potentially form the basis for campaigns by animal advocacy organisations in other developing countries.

How can we look for countries with lower meat consumption?

When it comes to the relationship between meat consumption per capita and wealth, we are interested in two types of outliers. These are visualised in the conceptual graphs shown in Figure 2, below.

- The first type of outliers we will call 'raw outliers'. Imagine we produce a graph showing a number of countries for a particular year. The horizontal axis shows the GDP per capita, and the vertical axis shows meat consumption per capita (Figure 2A). The data points would show a positive correlation (grey points). But there may also be some countries that sit below the trend, meaning that their value for meat consumption per capita is lower than would be expected for the country's GDP per capita. These countries are indicated in Figure 2A using an arrow and gold data points.
- The second type of outliers we will call 'slope outliers'. Imagine we produce a graph showing a number of countries for a particular year. The horizontal axis simply lists all of the countries. The vertical axis shows the slope of meat consumption per capita over time. A positive value means that the country's meat consumption per capita has

increased over the years. A zero or negative value means that the country's metric has not increased over the years. This means that the country's value for a given metric has remained steady, or has decreased, even as the country develops (assuming the country's GDP per capita has indeed increased over time). These countries are indicated in Figure 2B using an arrow and blue data points.

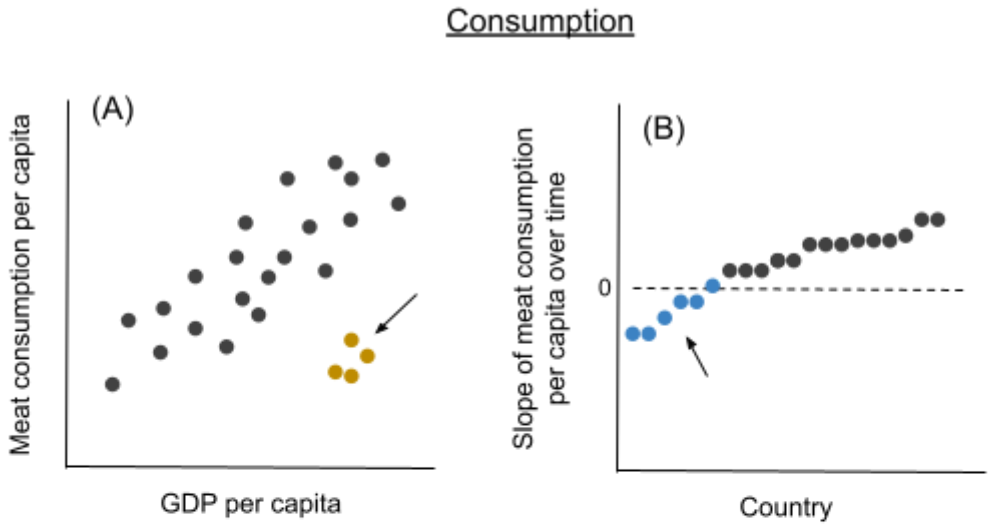


Figure 2: Conceptual graphs showing our approach for analysing meat consumption. A = graph of GDP per capita against meat consumption per capita, with countries with comparatively low meat consumption highlighted in gold (see Figure 3). B = the rate of change of meat consumption per capita over time, with countries with falling or steady meat consumption highlighted in blue (see Figure 4).

To examine the relationship between GDP per capita and meat consumption per capita - and to identify interesting, outlying countries (as shown in Figure 2) - the steps in our analysis were as follows. For access to our raw data and R code, see the appendix of this report.

We obtained data on countries' meat consumption per capita, fish consumption per capita, and GDP per capita from Our World in Data. Meat consumption per capita and fish consumption per capita are each measured in kg per year. Wealth is measured as GDP per capita, given in international dollars. The data covers the period between 1961 and 2017, plus some older, historical data points.

We cleaned the data as follows:

- We added meat consumption per capita and fish consumption per capita together to create a new variable: meat + fish consumption per capita.
- We removed entities that did not correspond to individual countries (e.g. supranational bodies, continents).

- We removed data points prior to 1961, as the data contained some older, historical records.
- We removed data points that did not have data for *all three of* meat consumption per capita, fish consumption per capita, and GDP per capita. This allows us to compare, for each country, the trend in meat + fish consumption and GDP per capita across a single, consistent time period.

Firstly, we wanted to reproduce Figure 2A, which means identifying countries with unexpectedly low values for meat + fish consumption per capita, given their wealth. We did so, and the resulting graph is Figure 3. We did this as follows:

- We produced a graph of per capita meat + fish consumption vs GDP per capita for one year (Figure 3). We chose 2017, as this is the most recent year with complete data.
- There is no formal way to identify countries that have unexpectedly low values for meat + fish consumption per capita. Therefore, we simply identified countries in the lowest 10% of meat + fish consumption per capita, compared to what would be expected from their GDP per capita. In technical terms, we identified the 10% of countries with the lowest residuals for the relationship between meat + fish consumption per capita and GDP per capita. We chose the value of 10% arbitrarily.

These countries are coloured in gold in Figure 3.

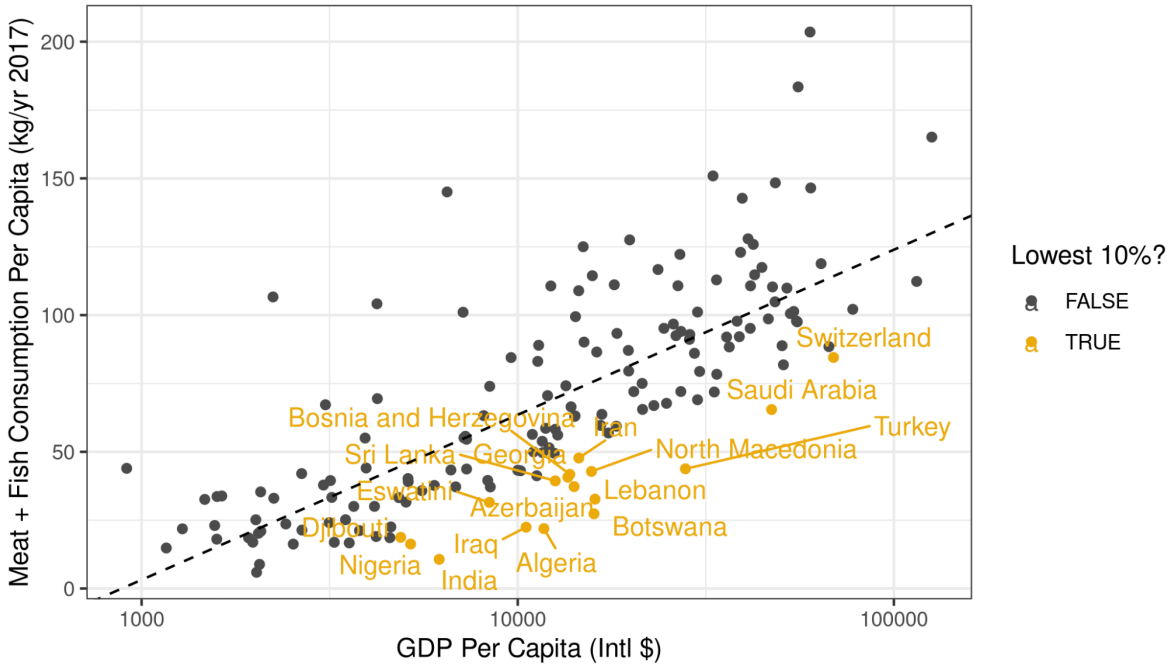


Figure 3: Income (GDP per capita, in international dollars) versus per capita meat + fish consumption for 2017. Countries highlighted in gold are in the lowest 10% of residuals, meaning that these countries have a meat + fish

consumption per capita that is much lower than would be expected based on their income. Note that the horizontal axis is logged. This graph corresponds to the conceptual graph shown in Fig 2A.

Secondly, we wanted to produce Figure 2B, which means identifying countries with unexpectedly low *changes in* meat + fish consumption per capita over time, given their change in wealth over time. We did so, and the resulting graph is Figure 4. We did this as follows:

- For each country, we calculated the rate of change (slope) of meat + fish consumption per capita over time. And we calculated the rate of change (slope) of GDP per capita over time. We also calculated 90% confidence intervals for each of those two slopes.
- We limited this analysis to countries with a positive rate of change (slope) for GDP per capita over time. This means that we ignore countries that did not see an increase in wealth over the time period of the data set.
- We limited this analysis to countries that, for at least one year in the data set, had a GDP per capita below $15,000. This means that we ignore countries like Switzerland, which were wealthy to begin with.
- We limited this analysis to countries where the range of values for GDP per capita was at least $1,000. This means we ignore countries that experienced only small wealth increases (below $1,000) over the time period of the data set.
- We limited this analysis to countries with at least 3 years with data for both GDP per capita and meat consumption per capita.
- We produced a graph showing the rate of change (slope) of meat + fish consumption per capita (and the 90% confidence interval) for each country, ordered from lowest slope to highest slope (Figure 4).
- We wanted to identify countries that meet all of the above criteria and for which the country's slope for meat + fish consumption per capita over time is zero or negative. This criterion means that the country did not see an increase in meat + fish consumption per capita over the data's time period. (Rather than use the estimate of the country's slope for the second criterion, we used the lower bound of the 90% confidence interval for the slope - this lets us include more potentially interesting countries.)

These countries are coloured in blue in Figure 4.

We have chosen not to include milk or egg consumption per capita. Really, the best way would be to combine all four, then convert to '# animals slaughtered per capita' or '# animals alive at any one time'. This would require some tricky calculations and assumptions - it would be a fruitful endeavour for the next study on this topic, but our current study is just a first

look. Sans and Combris found that meat is the most important of the four, though it's still possible for fish, eggs, or milk to increase over time even where meat doesn't.

Examining countries of interest in our dataset

Our results show that:

- Meat + fish consumption per capita and GDP per capita are strongly correlated (Figure 3)
- But there is variance in that correlation, meaning that there are countries with relatively low meat + fish consumption per capita for any particular value for GDP per capita (Figure 3, gold points)
- There are many countries that appear to have experienced an increase in GDP per capita but not meat + fish consumption (Figure 4, blue points).

These findings are consistent with the literature.

We have identified some countries of interest:

- The 10% of countries with the lowest meat + fish consumption per capita, given GDP per capita, are coloured in gold in Figure 3.
- The 22 countries that have developed but not meat consumption are coloured in blue in Figure 4. For each of those countries, a graph showing meat consumption per capita and GDP per capita over time is given in the appendix of this report.

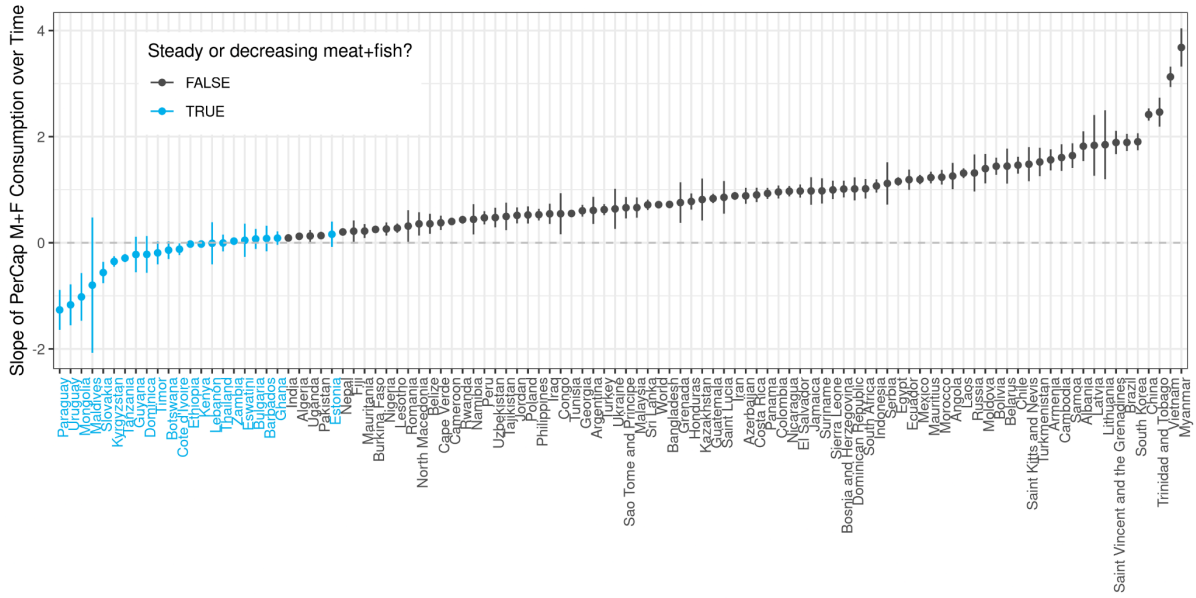


Figure 4: This graph gives, for each developing country meeting our criteria, the slope of meat + fish consumption per capita over time. A higher position (above 0) on the vertical axis means that the country's meat + fish consumption per capita has grown over time, while a lower position (below 0) means that it has fallen

over time. There are 22 countries highlighted in blue - these are the countries that have experienced a falling or steady meat + fish consumption per capita over time, despite having experienced economic growth. This graph corresponds to the conceptual graph shown in Fig 2B.

For each of the 22 countries highlighted in Figure 4, we have generated a detailed graph showing how meat + fish consumption and GDP per capita change over time (see Appendix).

Once the two sets of outliers were identified based on the country-level data, we investigated some especially promising countries in more depth. Our aim here was to find countries whose meat-consumption trends contain useful lessons for animal welfare strategy in other developing countries.

Owing to time constraints, we didn't investigate all the outliers in Figures 3 and 4 in more depth. Instead we focused mostly on the developing countries with meat consumption slopes that showed sudden trend changes. Our hope was that some of these trend changes were indicative of policy choices that could be reproduced in other countries.

Some countries have low absolute consumption

First, we'll take a brief look at the outliers in Figure 3 (gold), those countries with low levels of fish + meat consumption given their level of GDP per capita. We didn't research any of these countries in depth. Of these 17 countries, 9 look like promising avenues for further investigation, while 8 are less relevant. In the table below, we give a simplified summary of these 17 countries, after which we discuss each country in detail.

Countries	Relevant to further research?	Explanation
Switzerland, Saudi Arabia, Turkey	No	These are not low or low-middle income countries
Algeria, Djibouti, Iraq, Iran	No	The aridity in these countries causes meat prices to be high, which appears to be the reason for low meat consumption. This isn't replicable in other countries.
Lebanon	No	Low meat consumption is explained by the general economic crisis.
Botswana, Nigeria, Sri Lanka	Yes	Meat is relatively cheap, yet

		consumption is still low. The cause may or may not be replicable, so future research could investigate these countries in detail.
North Macedonia, Bosnia and Herzegovina, Georgia, Azerbaijan, Eswatini	Yes	Meat is relatively expensive, but it's not clear why. The cause may or may not be replicable, so future research could investigate these countries in detail.
India	Possibly	Low meat consumption appears to be caused by cultural and religious factors. There may still be geographic or temporal variance in vegetarianism (e.g. some regions consuming less meat than others) that could contain useful lessons.

Less relevant countries for baseline consumption

The 8 irrelevant countries are irrelevant for three different reasons. Firstly, Switzerland, Saudi Arabia, and possibly Turkey aren't developing countries, so they aren't as relevant to this report. Secondly, Djibouti, Iraq, Algeria, and Iran are all especially arid countries, and all have unusually high meat prices, which plausibly explains the low levels of consumption. Thirdly, Lebanon's low levels of meat consumption is a result of the general economic crisis.

Looking at Numbeo data on beef and chicken as a percentage of total food expenditure (using the fixed 'Asian food composition' basket), a sample of twenty random LMICs averaged 37% of total food expenditure on beef and chicken. On the other hand, in the five most arid countries on Earth, beef and chicken made up 47% of total food expenditures. In light of this data, that Djibouti, Iraq, Algeria, and Iran average 45% seems fairly typical for arid countries. While this data isn't conclusive, it suggests a correlation between aridity and high meat prices, which plausibly explains low levels of meat consumption in arid countries. This hypothesis could be more conclusively tested via a regression examining the relationship between annual rainfall and meat consumption or prices across all countries (while controlling for GDP per capita). On the assumption that this hypothesis is sound, arid

countries with low meat consumption (and high meat prices) probably don't contain especially useful lessons for animal welfare policy in other countries.

In the case of Lebanon, the decline in per capita meat consumption is probably explained by the extremely high meat prices (62% of total food expenditure) that are a result of the general economic crisis. This is corroborated by the Lebanon graphs of the raw data for meat + fish consumption and wealth contained in the Appendix of this report.

More relevant countries for baseline consumption

This leaves nine countries with low absolute levels of meat consumption that are relevant to our project. These countries are Lebanon, North Macedonia, Bosnia and Herzegovina, Georgia, Azerbaijan, Eswatini, India, Botswana, Nigeria, and Sri Lanka. These nine countries can be divided into two groups, leaving India as a special case.

- The first group includes Botswana, Nigeria, and Sri Lanka. In these three cases, meat prices are relatively low. Using the same Numbeo data as above, beef and chicken account for 33% or less of total food expenditures in all three countries. This is below the LMIC average of 37%. So, these countries have low meat consumption *despite* having low meat prices.
- The second group includes North Macedonia, Bosnia and Herzegovina, Georgia, Azerbaijan, and Eswatini. For each of these countries, beef and chicken make up 43% or more of total food expenditures. This suggests the causes of low meat consumption in these countries do operate (at least partly) via raising meat prices. As none of these countries are especially arid, it's unclear what these causes might be at this stage. Based on the Numbeo data, meat seems disproportionately expensive in the poorest European countries, which may help to explain the prices in the three European countries, though it's still unclear what the mechanism might be. (The mechanism may also help explain Slovakia's decline in meat consumption, which we discuss later in this report.)
- This leaves India. India's low level of meat consumption is mostly explained by high rates of vegetarianism among Hindus, but there are a number of caveats to this. Firstly, even if this is true, keeping rates of vegetarianism high within India could still be a major priority for animal advocates, given the large population and rising wealth of the country. Secondly, rates of vegetarianism across the country and across different social groups vary significantly (25), so Indian states with low rates of vegetarianism might still contain lessons about meat consumption that apply to other countries. Finally, if the link between Hindu belief and vegetarianism has grown stronger over

time, Indian culture and policy may still contain lessons for public outreach in other countries. (Of course, care must be taken given the relationship between vegetarianism, nationalism, and caste in India.)

Some countries have a falling or steady consumption over time

Next we'll discuss the countries identified in Figure 4 as having a falling or steady level of meat + fish consumption over time, despite having experienced economic growth. There are 22 of these countries, and we investigated nine of these in more depth to check the validity of the country-level consumption trends (Slovakia, Thailand, Uruguay, Paraguay, Botswana, Tanzania, Kyrgyzstan, Kenya, and Ethiopia). We investigated in-depth. This leaves 13 countries for future investigations: Mongolia, Maldives, Guyana, Dominica, Timor, Cote d'Ivoire, Lebanon, Zambia, Eswatini, Bulgaria, Barbados, Ghana, and Estonia.

These nine countries were selected due to either having an especially clear divergence in their meat + fish consumption and GDP per capita trends (Tanzania, Kyrgyzstan, and Botswana), or showing sudden discontinuities in their consumption trends (Slovakia, Thailand, Paraguay, Uruguay, Kenya, and Ethiopia).

Here's a table summarising our research into these outliers we identified in Figure 4.

Country	Policy/Strategy Relevant?	Explanation
Slovakia	Yes	Ending of meat subsidies in the early 1990s plausibly contributes to a sustained (25-year) decline in meat consumption.
Thailand	Yes	Meat consumption plateaus at an unusually low level from the ~1992 onward. The causes are unknown. However, the quality of the data may be suspect.
Lebanon	No	As in above table, this is a result of the general economic crisis.
Ethiopia and Kenya	No	The decline is likely due to the 2011 East African Drought.
Paraguay and Uruguay	Mostly no (except the Uruguayan removal of beef subsidies during the 1990s)	The decline is mostly due to rising beef exports, which only correspond to a domestic, not

		international, decline in meat consumption.
Botswana, Kyrgyzstan, Tanzania	Unclear	There is very little information explaining the trends in Botswana and Kyrgyzstan. Tanzania's low levels of consumption seems overdetermined by a raft of economic inefficiencies, but other aspects may be relevant.
Mongolia, Maldives, Guyana, Dominica, Timor, Cote d'Ivoire, Zambia, Eswatini, Bulgaria, Barbados, Ghana, and Estonia	Unknown	Due to time constraints, we did not investigate these in detail, and all are promising avenues for further research.

We will briefly explain these findings here, before giving a detailed discussion and explanation below.

Two countries were potentially promising (Slovakia and Thailand). These countries may suggest lessons for averting the global development of factory farming:

- The sustained consumption decline in Slovakia may be a result of ending consumer subsidies in the early 1990s. If this is true it's very encouraging that the effects of such policy changes could be so long lasting. We didn't encounter any explanations of the sudden uptick in meat + fish consumption around 2015. It's possible that this uptick was the result of policy changes. If this is the case, avoiding analogous policy changes in other countries may be a priority.
- Thailand plateauing at a moderate level of meat + fish consumption remains unexplained. It looks like rising exports (as in Paraguay and Uruguay) don't explain this trend. Additionally, the FAO consumption data may be called into question due to its reliance on Thailand's fisheries catch data, the accuracy of which has been criticised by academic studies. We are unsure whether there is a strong reason to be sceptical about this data.

Five of the countries' trends didn't suggest any lessons for averting the global development of factory farming (Lebanon, Kenya, Ethiopia, Paraguay, Uruguay).

- As we mentioned above, Lebanon's decline in per capita meat consumption is probably a result of the general economic crisis.
- The decline in Ethiopia and Kenya is likely due to the 2011 East African Drought.

- The consumption decline in Paraguay and Uruguay is likely due to rising beef exports, so mimicking their policies probably won't help to reduce the consumption of animal products globally. The exception is Uruguay's removal of domestic beef price controls in the 1990s, which is relevant.

Three countries were inconclusive (Botswana, Kyrgyzstan, Tanzania).

- The literature around meat consumption in Botswana and Kyrgyzstan lacked deeper explanations of the FAO data, though it's possible that more information could be pieced together through relevant government reports.
- Low meat consumption in Tanzania seems overdetermined by a range of economic factors, but these factors all seem quite harmful for economic development, and hence aren't worth pursuing. It's possible that comparing Tanzania with similar countries (or comparing different regions within Tanzania) could uncover additional factors explaining the low meat consumption which aren't economically harmful, which may provide a basis for policy in other countries.

Promising country #1: Slovakia

Now we can move on to Slovakia and Thailand, which are the most encouraging cases we investigated in depth.

Slovakia became an independent country in 1993, Czechoslovakia dissolved into Slovakia and Czechia. As such, meaningful data for Slovakia is only available from 1993. (Immediately after Czechoslovakia dissolved, per-capita meat consumption was higher in the Czechia than in Slovakia, so using data from Czechoslovakia would overestimate the actual consumption in the lands that would become Slovakia.)

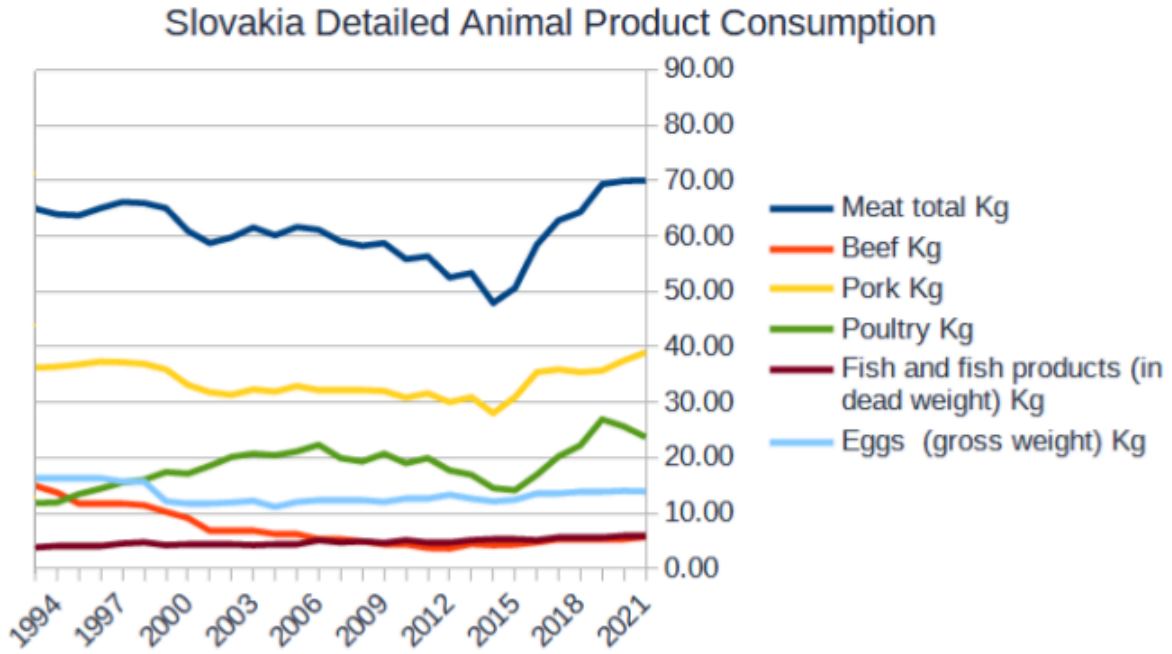


Figure 5: The per-capita consumption of meat and animal products in Slovakia over time. The first year in the data is 1993. Data source: FAO Food Balances data.

Looking at the graph of animal product consumption in Slovakia, we see a steady decline between 1993 and 2014, followed by a sudden uptick beginning in 2015.

When we consider that Slovakia's economy grew during this period (a graph of the GDP per capita is available in the Appendix), this sustained decline in meat consumption remains mysterious. Slovakia enjoyed roughly 5% annual per capita GDP growth between 1993 to 2008. The consumption data for Czechia shows the same initial steep decline in the early 1990s, but notably lacks the sustained decline over the next 20 years that makes Slovakia such an anomaly. This is despite Slovakia staying at roughly 85% of Czechia's per capita GDP throughout the entire period.

As we did, Hupkova et al (26) note that Slovak incomes grow from 1995. The authors note that this coincides with the rise in poultry consumption that flattens out the overall decline in meat and fish consumption. They also claim that rising beef prices in EU member states, plus the outbreak of bovine spongiform encephalopathy in 2000/2001, contribute to the sustained decline in beef consumption. However, this still leaves us with a number of questions. Why did per capita pork consumption also decline until the 2010s? Why did chicken consumption decline from 2006? Why were the declines in beef and pork consumption strong enough to drag down Slovakia's overall trend while Czechia remained steady?

Prokeinova and Hanova (27) point out that, in the early 1990s, Slovakia abolished subsidies for the production and consumption of meat. We were unable to find more detail on the precise nature of these subsidies, beyond an expert telling us that these subsidies included a negative sales tax on beef (28). However, if the removal of consumption subsidies in the early 1990s really is the key factor explaining the long term decline, this is potentially encouraging for the animal advocacy movement. If this hypothesis is sound, it suggests that removing consumption or production subsidies in countries with unusually high levels of meat consumption may have especially long-lasting effects.

This hypothesis may be corroborated by the removal of domestic price controls leading to a decline in beef consumption in Uruguay (which we discuss below). The obvious downside to these points is the fact that they seem to have the strongest effect on the consumption of beef, and possibly pork, which are likely less harmful from an animal welfare production than the consumption of chicken (9–11). In developed countries, where chicken acts as a substitute for beef and pork, this may mean that this policy can cause more harm to animals than good (9–11). (This conclusion may differ in some low-income countries if chickens are raised extensively by families, rather than intensively on large-scale farms.)

Promising country #2: Thailand

Moving on to Thailand, we see that meat + fish consumption appears to peak in 1992, and then very gradually decline from then on (Figure 6, bottom panel). It plateaus at around 55 kg of per capita consumption - significantly lower than other countries in the region, such as Myanmar (108 kg), China (102 kg), and Vietnam (94 kg) (FAO 2019 per capita consumption data). This plateau in meat + fish consumption, despite further steady economic growth, is encouraging - but it comes with a major caveat.

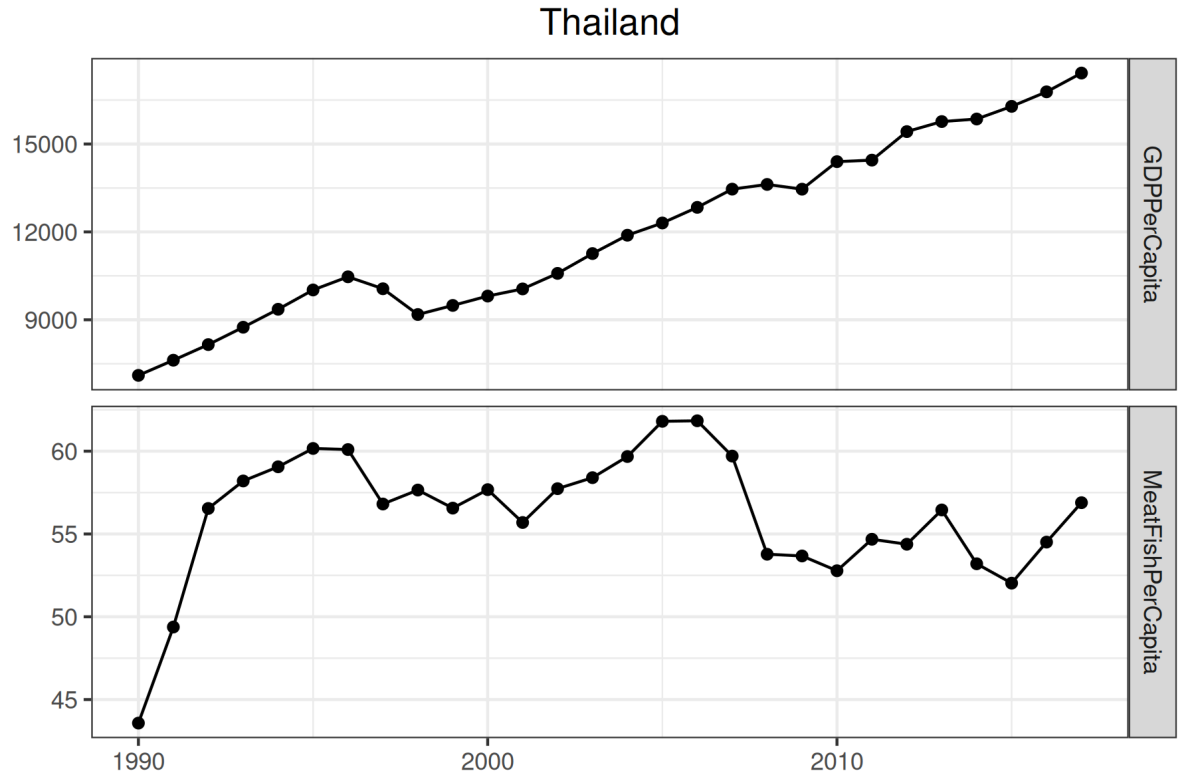


Figure 6: Thailand's GDP per capita (top) and meat + fish consumption (bottom) over time. Data source: Our World in Data (See "Data and Analysis", above).

Derrick et al (28) investigated the marine fisheries catches that Thailand reported to the FAO between 1950 and 2014 and found that reconstructed fisheries catches were nearly three times larger than the data Thailand reported to the FAO. While Derrick et al's investigation only focused on reported catch data, not domestic consumption data, it might suggest that some of Thailand's trend is an artefact of the data. We haven't found any resources either confirming or disconfirming the possibility that this underreporting applies to the FAO consumption data for Thailand as well (and we are exploring this point with experts). In the absence of any such confirmation, we can note that Derrick et al seem to regard the post-1970 consumption data reliable enough to use it to estimate small-scale fisheries catches during the period, which is some encouragement.

If the FAO consumption data is accurate, we can ask what might explain the plateau that we have identified. Unfortunately, we were unable to find any conclusive explanations.

We do not think that this plateau can be explained by exports. Thailand is a major exporter of chicken, and even more so of fish, so we considered exports raising prices and displacing domestic consumption as a hypothesis. However, unlike in Paraguay and Uruguay, Thailand primarily exports non-luxury meats - therefore, rising prices would not necessarily displace

domestic consumption. Additionally, Piumsombun (29) notes: “Despite the fact that Thailand is a net fish exporting country, domestic per capita fish consumption is relatively high compared to consumption of other three main animal protein commodities, namely pork, beef, and chicken”. Piumsombun’s data also shows that per capita fish consumption rose by 3% per annum between 1980 and 2000. This was the period that Derrick et al argue contains the greatest increase in catches, further supporting the idea that rising fish exports can’t explain flat domestic consumption post-1992.

In light of this, we are still unsure what might explain the plateau in Thailand’s meat + fish consumption, so further research in this area may be beneficial.

Four countries are false positives (Kenya, Ethiopia, Paraguay, Uruguay)

Looking at the four ‘false positive’ countries, they fall into two groups. The meat + fish consumption declines in Kenya and Ethiopia are likely a result of the 2011 East African Drought. The declines in Paraguay and Uruguay are likely due to rising beef exports displacing domestic meat consumption despite the overall increase in domestic meat production.

Kenya and Ethiopia both show a significant and lasting decline in per-capita meat consumption beginning around 2010-12, coinciding with the 2011 East African Drought. Though we didn’t look for sources that aimed to establish the causal relationship between the drought and the decline in meat consumption, it is plausible that it was significant, so we de-prioritised investigating Ethiopia and Kenya in more depth. It’s worth mentioning that other sources do provide alternate explanations for the decline in Ethiopia, with Whitton et al (24) claiming: “Decrease in per capita meat consumption in Nigeria and Ethiopia is also driven by population growth with meat consumed only on special occasions.”

Paraguay and Uruguay are a more interesting case. Nin et al. (30) examine domestic beef production in Paraguay and Uruguay from the 1970s and find that both countries underwent a significant increase in their beef production and beef exports during the period, especially between ~1990 and the mid 2000s, yet their beef consumption steadily declined during the period. Specifically, Paraguayan beef consumption peaked at 44 kg/capita in 1992, and bottomed out at 11 kg/capita in 2009, and Uruguayan beef consumption peaked in 1994 at 63 kg/capita, and bottomed out in 2007 at 19 kg/capita (FAOSTAT Food Balances data). Both countries' beef consumption remained relatively flat through the 2010s as well (FAOSTAT Food Balances data). Whitton et al. (24) explicitly connect this decline to an increasingly lucrative export market displacing domestic consumption in the case of Paraguay. Nin et al. (30) attribute Uruguay’s increase in beef exports/production and simultaneous decline in

domestic consumption to a number of liberalising economic policy changes during the 1990s. The most important changes included the lifting of export taxes and various domestic beef subsidies and price controls (similar to the case of Slovakia).

Nin et al. (32) discuss three likely aspects of the causal chain: increasing exports causes increasing domestic beef prices, which causes lower domestic meat consumption. Firstly, as beef exports to wealthier markets increased, this drove up the price of scarce inputs like land (and possibly calves), leading to a higher floor on domestic prices. Secondly, in order to secure access to more demanding export markets, both countries introduced strict quality and health controls during the 1990s and 2000s. This increased domestic production costs, which was plausibly passed on to consumers. Finally, soybean production and exports also increased significantly in both countries during this period, which may have increased land prices, and hence the cost of beef production, by restricting the supply of cheap pasture.

This explanation of beef exports displacing domestic meat consumption seems broadly plausible, especially considering the unusually central role of beef as a staple food in both countries. Aside from the removal of domestic price controls in Uruguay (a policy change also present in Slovakia), it seems like declining meat consumption in Uruguay and Paraguay doesn't suggest any policy proposals for reducing meat consumption in developing countries as a whole. Rather, this seems to be a case of reducing consumption in one country while increasing it elsewhere. It is worth noting that good long-run data showing an increase in the domestic price of meat, especially beef, in both countries during this period would provide stronger evidence for our hypothesis that exports displaced domestic consumption. Unfortunately we've so far been unable to find such data for the relevant period.

Three countries are inconclusive (Botswana, Kyrgyzstan, Tanzania)

We now move on to the three inconclusive countries. In the case of Botswana and Kyrgyzstan, our literature review didn't uncover any deeper explanations of the trends in the FAO data. Our review was somewhat preliminary, so it's possible a more thorough investigation - especially of relevant government policy reports - could uncover more useful information.

Our investigation into the causes of Tanzania's declining meat + fish consumption wasn't especially encouraging, though we found more relevant information than in the case of Botswana and Kyrgyzstan. Hartwich et al (31) and Wang et al (32) both present a picture of widespread production inefficiency hampering levels of meat consumption. Hartwich et al focus on red meat production, where they note that low levels of red meat consumption may be caused by poor vertical integration, a lack of access to credit, opaque markets, and a

general lack of demand for (or regulation of) meat quality. Wang et al note general inefficiencies associated with small-scale, mostly household-level production of animal products in rural areas as another factor.

Neither of these sources compared the prevalence of these factors in Tanzania with other economically similar countries with rising meat consumption. As a consequence, it's difficult to determine which of these factors explain the unusual trend in Tanzanian meat + fish consumption. So, further research examining trends in different regions within Tanzania, or comparing Tanzania with similar countries could be productive. However, even if some of these features of the Tanzanian market were identified as being responsible for the declining meat + fish consumption, it's difficult to see how they could be turned into worthwhile policy recommendations. If the animal advocacy movement seeks to prevent the intensification of animal agriculture in developing countries, while fully supporting human economic development, it doesn't look like recreating the conditions of Tanzania's meat market is a viable path forward.

Future research for consumption

We identified two countries with steady or declining meat + fish consumption: Slovakia and Thailand. It is possible that these steady/declining trends are due to policies that can be replicated in other countries. So, it could be worthwhile for the movement to investigate these two countries in greater depth. Also, we identified three countries with low *baseline* consumption (rather than a steady/declining *trend* in consumption): Nigeria, Sri Lanka, and Eswatini. It could also be worthwhile to investigate the reasons for this low consumption.

4. Production: How Does Animal Farming Become More Intensive as Countries Develop?

This section of the report will focus on the second of the two major drivers: the level of intensification of a country's animal agriculture sector.

Wealthier countries intensify their animal production, but there is variation

Published evidence supports the idea that countries, on average, intensify their animal agriculture sectors as wealth increases.

Steinfeld et al (33) describe, in general terms, how countries' animal agriculture operations evolve as the countries develop. As a country becomes wealthier and more urbanised, the demand for meat increases. This leads to the emergence of large-scale operators using intensive farming methods. Intensive farms initially emerge near towns and cities, where

demand is highest, before moving away from human populations as technology and infrastructure develops to enable this move.

Chaiban et al (34) analysed chicken farms in four countries: Nigeria, Thailand, Argentina, and Belgium. The authors found that intensification, as measured by the average number of chickens per farm, was higher in countries with a higher GDP per capita.

Gilbert et al (1) identified a few reasons why there may be a link between GDP per capita and the levels of intensification in animal agriculture. Wealth is both a 'cause and a consequence' of intensification. GDP per capita can drive intensification: wealthier people demand more meat, which creates an economic incentive for a country to invest in intensive animal agriculture; at the same time, to shift towards intensive production methods, producers require investments, which can be more easily found in countries with increasing incomes. But it is plausible that intensification can also drive GDP per capita: intensive animal agriculture can produce profits, which translate to higher incomes.

How can we look for countries with less intensive animal production?
When it comes to the relationship between intensive production and wealth, we take a similar approach as we did for consumption (above). However, the available data is more limited. As such, we are mainly interested in one type of outlier. This is visualised in the conceptual graph shown in Figure 7, below.

- There is limited data for 'raw outliers' (Figure 7A). We discuss this limited data below.
- Currently, there is insufficient data to consider 'slope outliers' for the proportion of intensive animal production (Figure 7B).

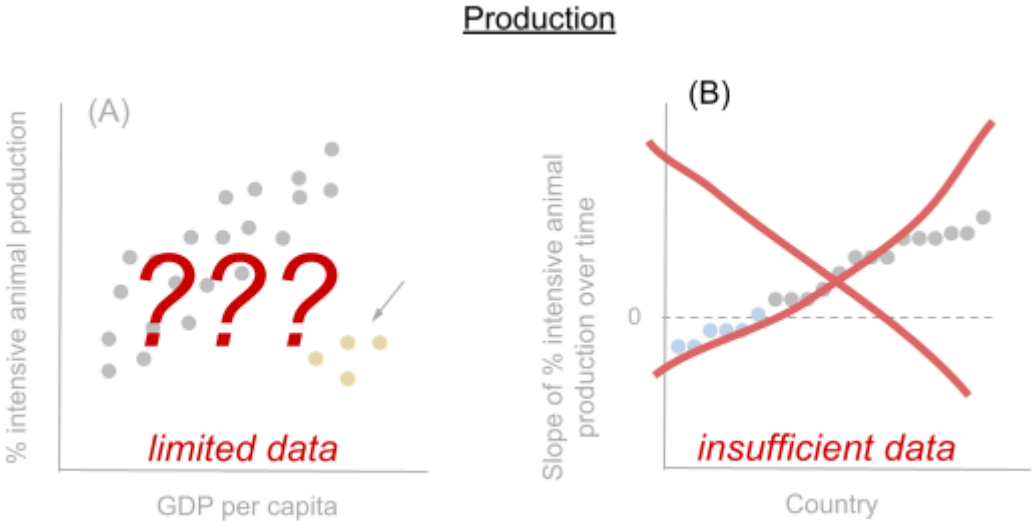


Figure 7: Research into the relationship between intensive animal production and wealth is hindered by data availability. There is only limited data for the relationship between wealth and the proportion of intensive animal production (A), and there is completely insufficient data for analysing the slope of the proportion of intensive animal production over time (B).

Gilbert et al provide the strongest quantitative analysis of the relationship between GDP per capita and intensification of animal agriculture. To measure the level of intensification of animal agriculture in a country, Gilbert et al (1) use the measure 'proportion of animals farmed under intensive systems'. The authors obtained data from various sources like government publications on the proportion of animals raised under intensive vs extensive production systems. This enabled the authors to produce a dataset covering 86 countries for chickens and 97 countries for pigs.

We have graphed this data below. There does appear to be some spread in the data - if you look at the data points with a GDP per capita between roughly $1,000 and $10,000 USD PPP, there are countries at similar levels of wealth (horizontal axis) but with very different levels of intensification (vertical axis).

There is less variance in the very wealthy countries. Above roughly $10,000 USD PPP, most countries have a very high proportion of intensively raised animals.

Nevertheless, this is quite a promising result - it suggests that it may be possible for countries to be relatively wealthy yet have low levels of intensification in animal farming.

Unfortunately, we were unsuccessful in contacting Gilbert et al to obtain the raw data. So, we cannot tell which country corresponds to which data point. It could be possible to deduce the countries' identities using careful detective work, as the graph in Gilbert et al also gives population data. Due to time constraints, we have not attempted to do this. (We're specifically interested in the graphs in Gilbert et al labelled Figure 2, which corresponds to our Figure 8 in the present report. Every other graph in their paper is supported by model projections which are available, but those graphs are less directly relevant for our purposes.)

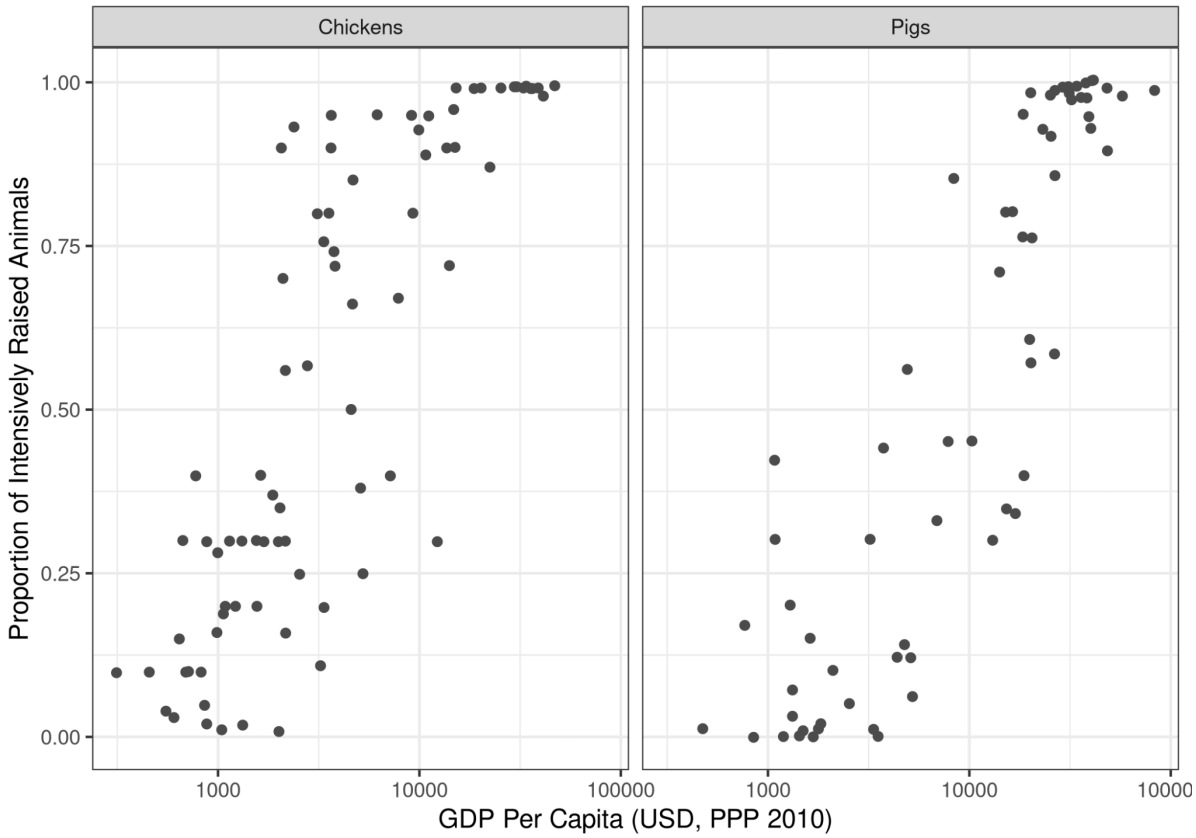


Figure 8: Data on wealth versus the proportion of intensively raised farm chickens (left) and pigs (right), from Gilbert et al (1). Note that the horizontal axis is on a logarithmic scale. This graph corresponds to the conceptual graph shown in Figure 8A.

There are other metrics that could be used. One candidate is the average scale of production, perhaps measuring the mean number of chickens per farm (33–35). However, we have not encountered data on the average scale of production for a large number of countries. The closest thing we found is data on average farm size, available from Our World in Data, but this focuses on plant agriculture. Another candidate is productivity, perhaps measuring the weight of meat produced per animal per year (1). This data is indeed available from Our World in Data. Broiler chickens farmed under intensive conditions generally have a higher productivity than those farmed under extensive conditions (36). However, the opposite trend has been observed for other animals like cows (37). Also, the breed of chickens used (fast-growing vs slow-growing) is a much stronger predictor of productivity than the production system (36). So, productivity is likely to be a poor proxy for a country's level of intensification.

5. General Discussion

You could also analyse different regions *within* a country

In this report, we have focused on analysing differences in consumption and production of meat products *between* different countries. However, it could be equally useful to look at different regions *within a single country*. If a country consists of different regions, or states, or territories, then it is possible that those different areas have different patterns of meat consumption or industrialisation of meat production. Perhaps one state within a country has become wealthier but has maintained a steady per-capita meat consumption, or maybe a particular region has been slower to industrialise its animal agriculture industry than other regions. If future research can identify such regions, then that might also be a promising place to search for policies that can slow the growth of industrial animal agriculture.

How could alternative proteins affect things?

We believe that influencing the trajectory of animal farming in developing countries should be a major priority for the animal advocacy movement, despite the small possibility that factory farming may be made obsolete by alternative proteins (e.g. currently available plant-based products, or future products made from cultivated meat). It is unclear how alternative proteins will develop in the future. We do not know whether alternative proteins will grow into a meaningful and permanent competitor for meat and animal products (38–40), and we do not know how the performance of alternative proteins will differ across countries. This means that relying on alternative proteins to prevent the colossal amount of animal suffering in the world's future is very risky. Separately, restricting factory farming may help alternative proteins take hold - some animal welfare improvements can make meat and animal products less economically competitive, and some improvements can even reduce the number of animals farmed in a country (41). As such, even if you are optimistic about alternative proteins, policies that restrict the growth of factory farming in developing countries are nevertheless an important tool for the animal advocacy movement.

The importance of human justice

Finally, we would like to emphasise that animal advocacy in developing countries is different from animal advocacy in developed countries in many ways. For example, many people and governments see the growth of animal agriculture as one pathway to economic growth and development. The issue of requiring animal welfare standards or limiting industrial growth for those living in poverty is the subject of debate (42). At the same time, issues facing humans such as poverty, disease, and food insecurity which makes it difficult for many people to see animal welfare as a priority (15). Furthermore, animal advocacy has a history of being used to oppress people who undertake practices that do not conform to dominant Western ideals (43–45). When people in developed countries advocate against particular practices

overseas, this can reinforce harmful racial prejudices (46,47). That said, animal welfare is not a concept unique to Western countries - in one study across a wide variety of countries, participants in all countries agreed that the welfare of both farmed and companion animals were important, and participants supported laws protecting animal welfare (48). The authors of this present report are based in wealthy, developed countries, and we acknowledge the bias and blindspots that this position brings. Our primary aim is to provide tools, including this report, to assist the work of animal advocates living and working in developing countries - indeed, one such collaboration with an organisation based in Uganda provided the initial motivation to write this report. We are aware of many animal advocacy organisations in developing countries that are enthusiastic about limiting the growth of intensified animal farming in their own countries, and it is this work that we aim to support.

6. Conclusion: Research Directions for the Animal Advocacy Movement

Based on the data and analysis in this report, there are some fruitful topics of research that would benefit the animal advocacy movement if explored further:

- Consumption: We identified two especially promising countries with steady or declining meat + fish consumption: Slovakia and Thailand. It is possible that these steady/declining trends are due to policies that can be replicated in other countries. The same applies for Uruguay's removal of domestic beef subsidies in the 1990s. So, it could be worthwhile for the movement to investigate these three countries in greater depth. Additionally, the twelve countries with a steady/declining trend in meat consumption which we didn't investigate in depth represent promising avenues for future research. Also, we identified nine countries with low *baseline* consumption (rather than a steady/declining *trend* in consumption): Botswana, Nigeria, Sri Lanka, North Macedonia, Bosnia and Herzegovina, Georgia, Azerbaijan, Eswatini, and India. It could also be worthwhile to investigate the reasons for this low baseline consumption.
- Production: It would be useful to improve upon the data in Figure 8 by figuring out which countries correspond to which data points. This would identify countries with levels of intensification in animal farming that are lower than would be expected based on those countries' wealth. Exploring why those countries have low levels of intensification may identify policies that could be replicated in other developing countries. This could be achieved by obtaining the raw data from Gilbert et al (although their model projections are available, our attempts to contact the authors for raw data have been unsuccessful), some careful detective work on the dataset, or by replicating the data collection that was conducted by Gilbert et al to create a new dataset.

- For both consumption and production, it could also be promising to compare different regions *within* a single country. This could also help identify policies that explain differences in meat consumption or the level of industrialisation between regions.

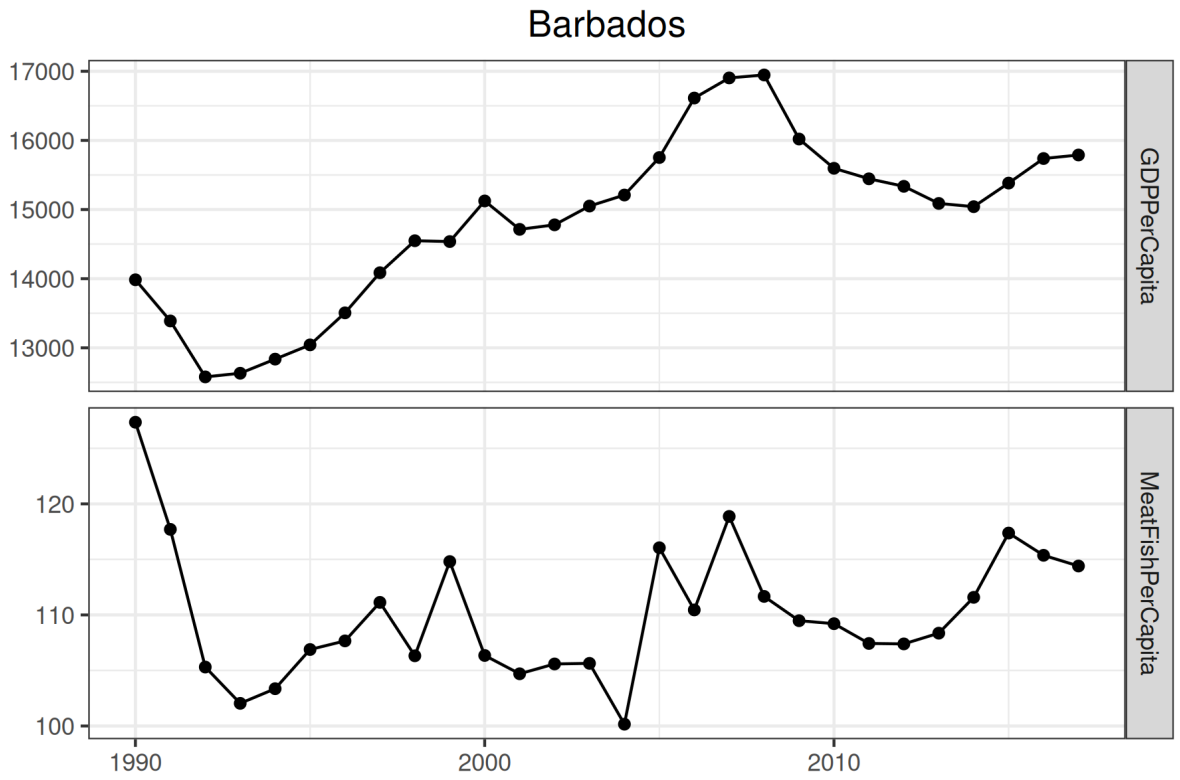
Acknowledgements

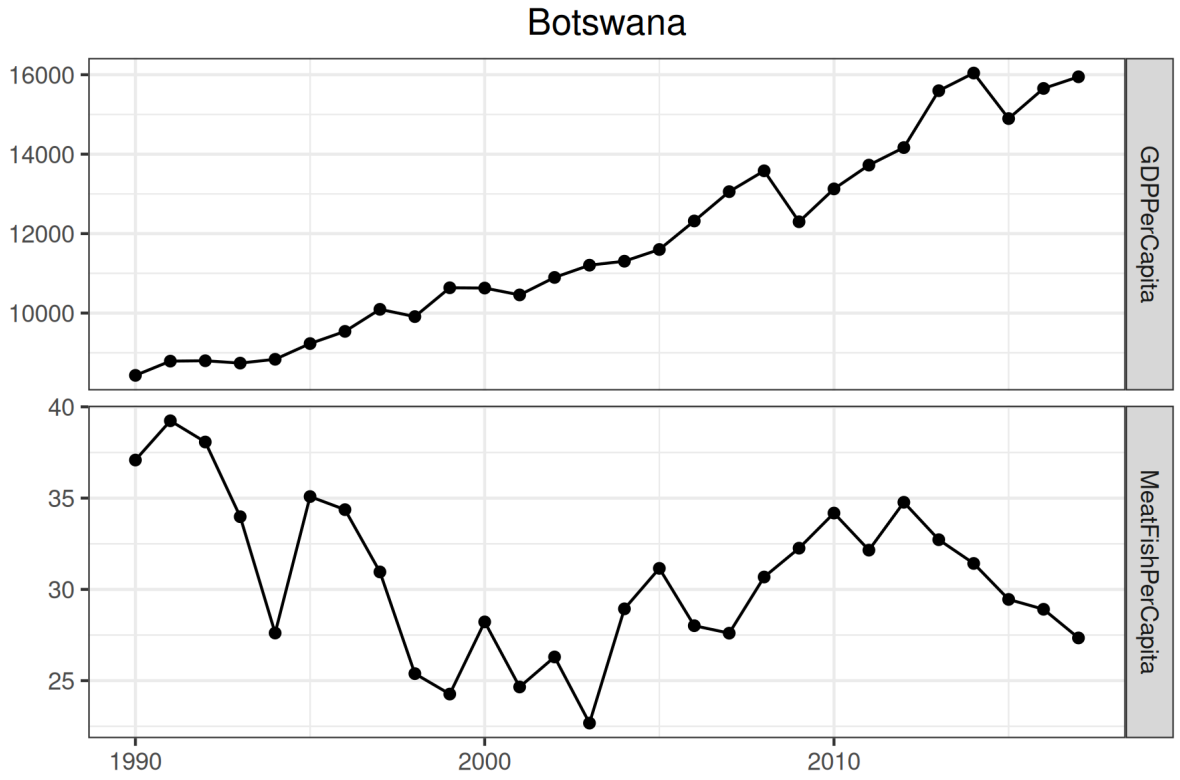
Thank you to the members of the Melbourne Effective Altruism community who provided useful comments on this report.

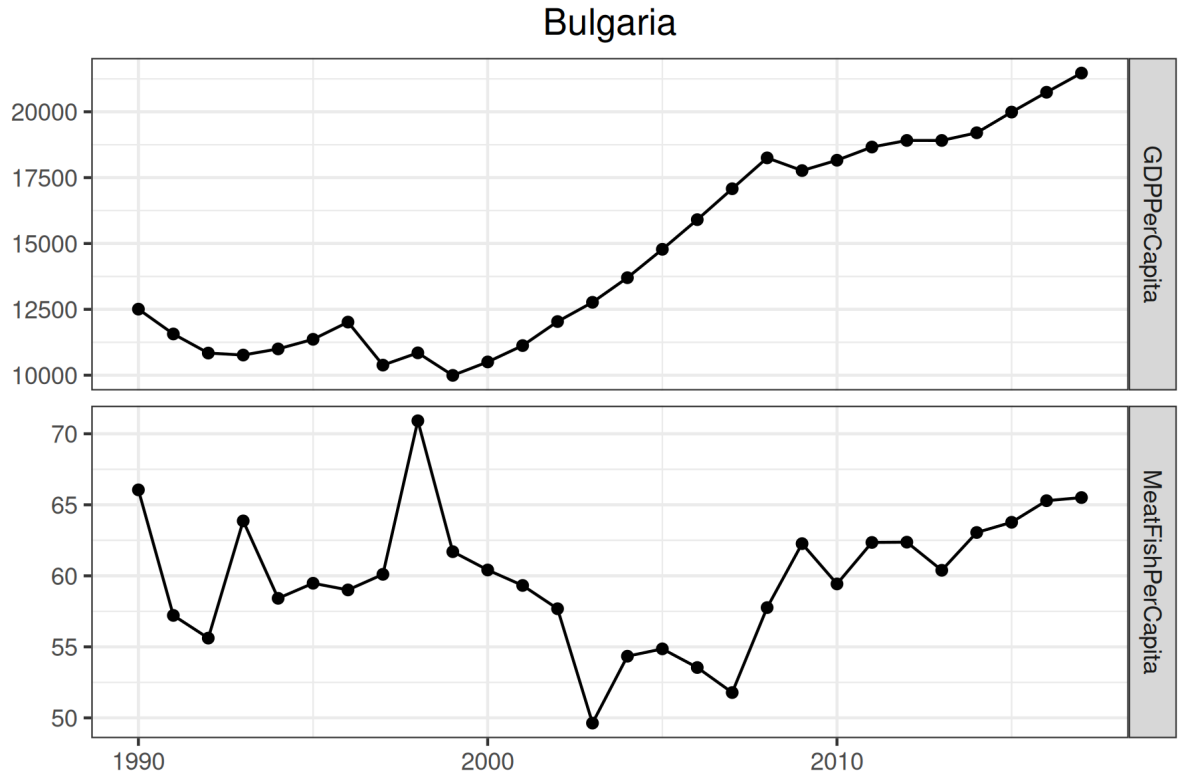
Appendix: Access to Raw Data and Code

The raw data, R code, and figures from this report can be accessed in the OSF repository here: https://osf.io/cfe5v/.

Appendix: Graphs of Raw Data for Consumption and Wealth



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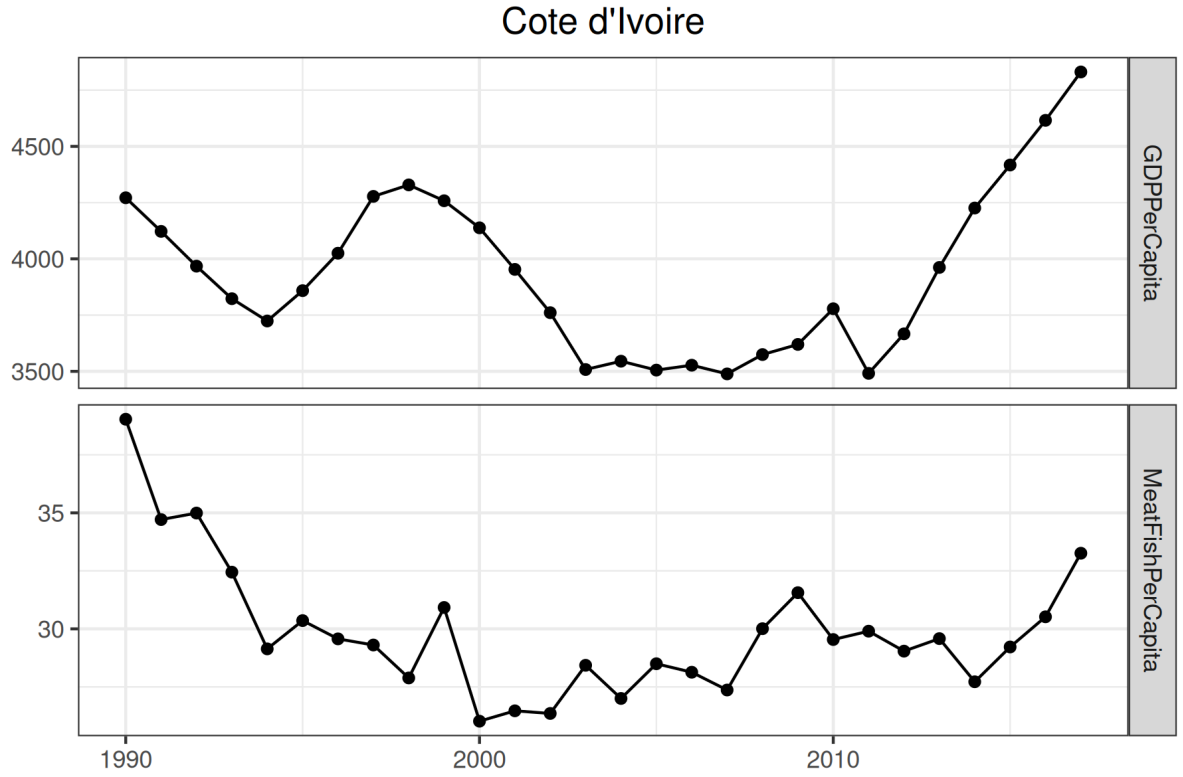
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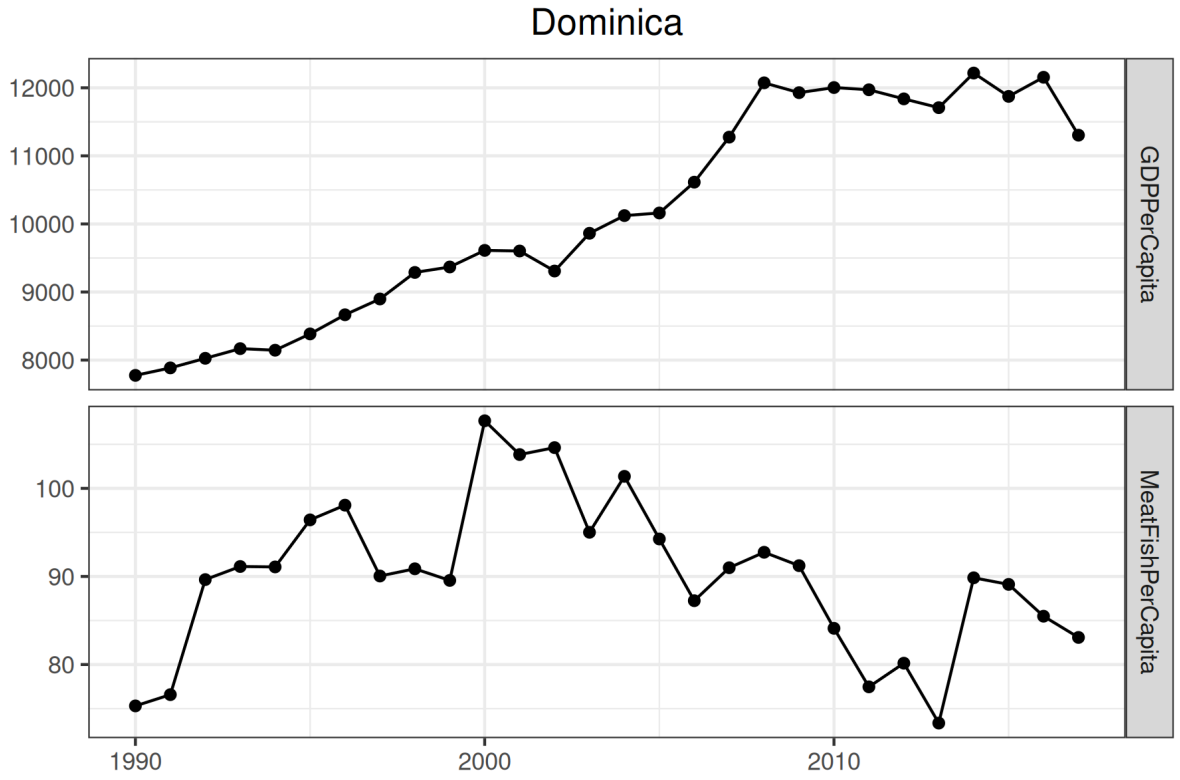
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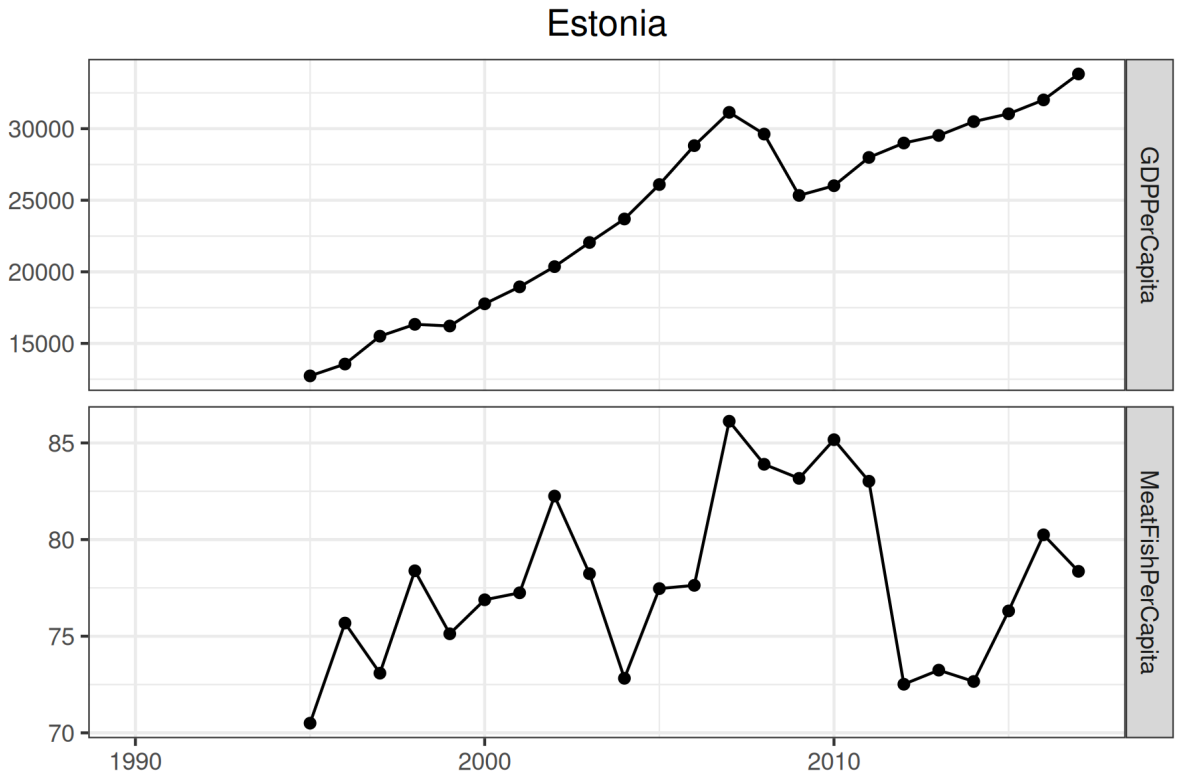
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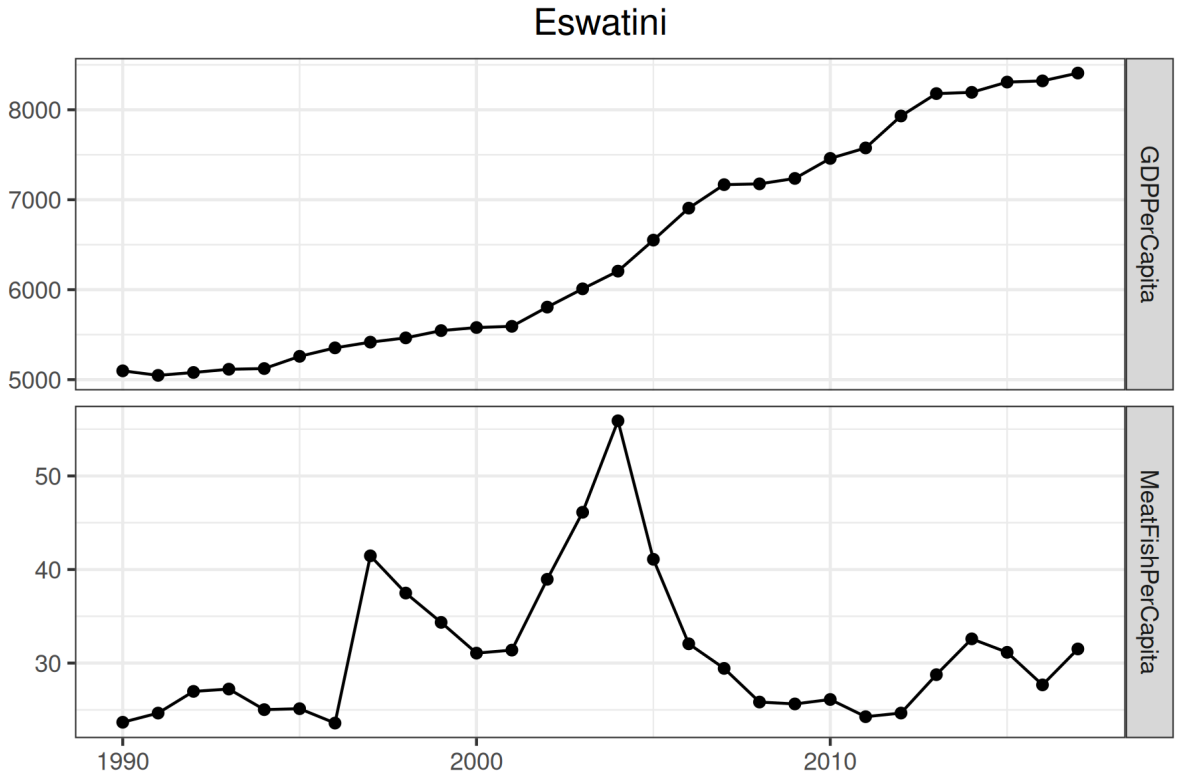
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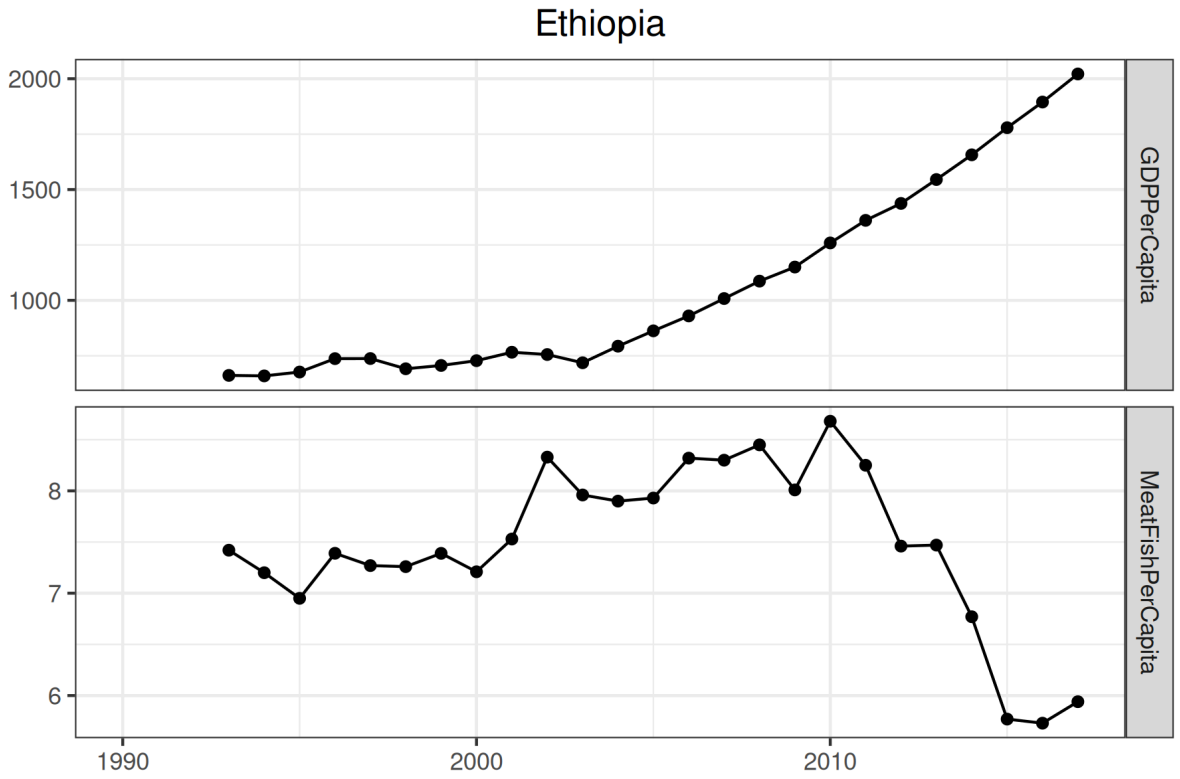
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2000
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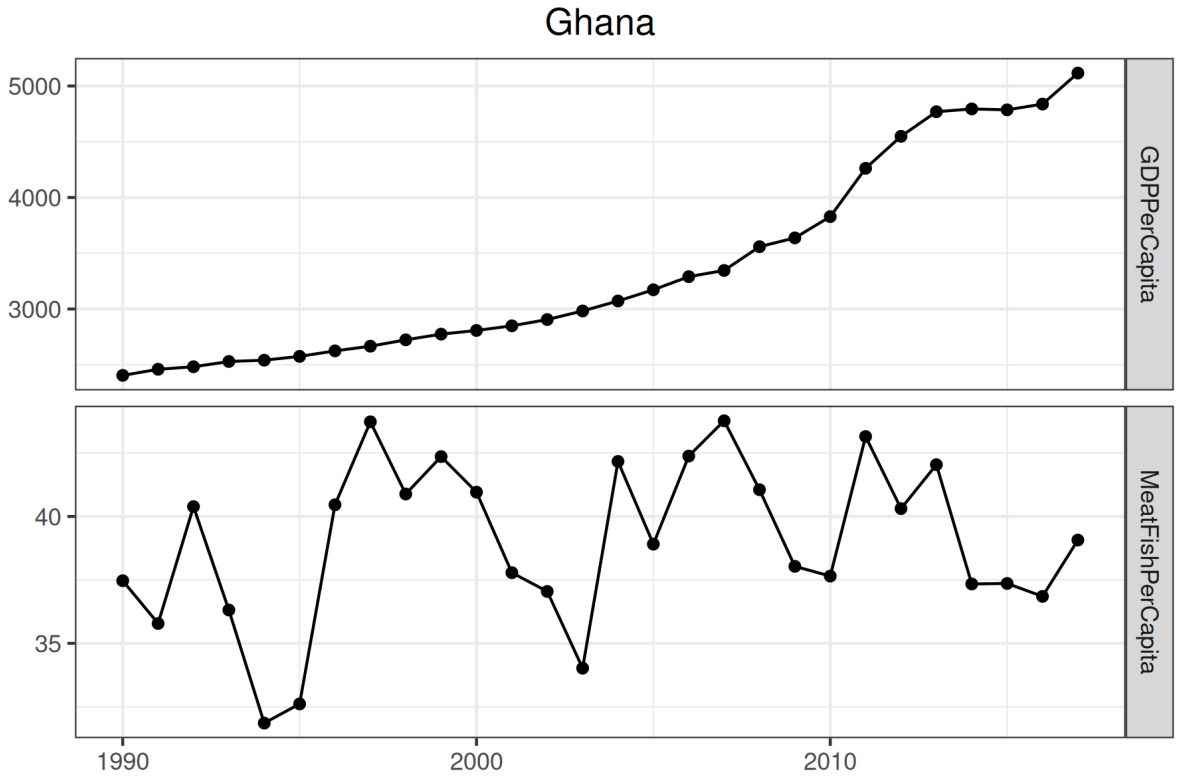
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35
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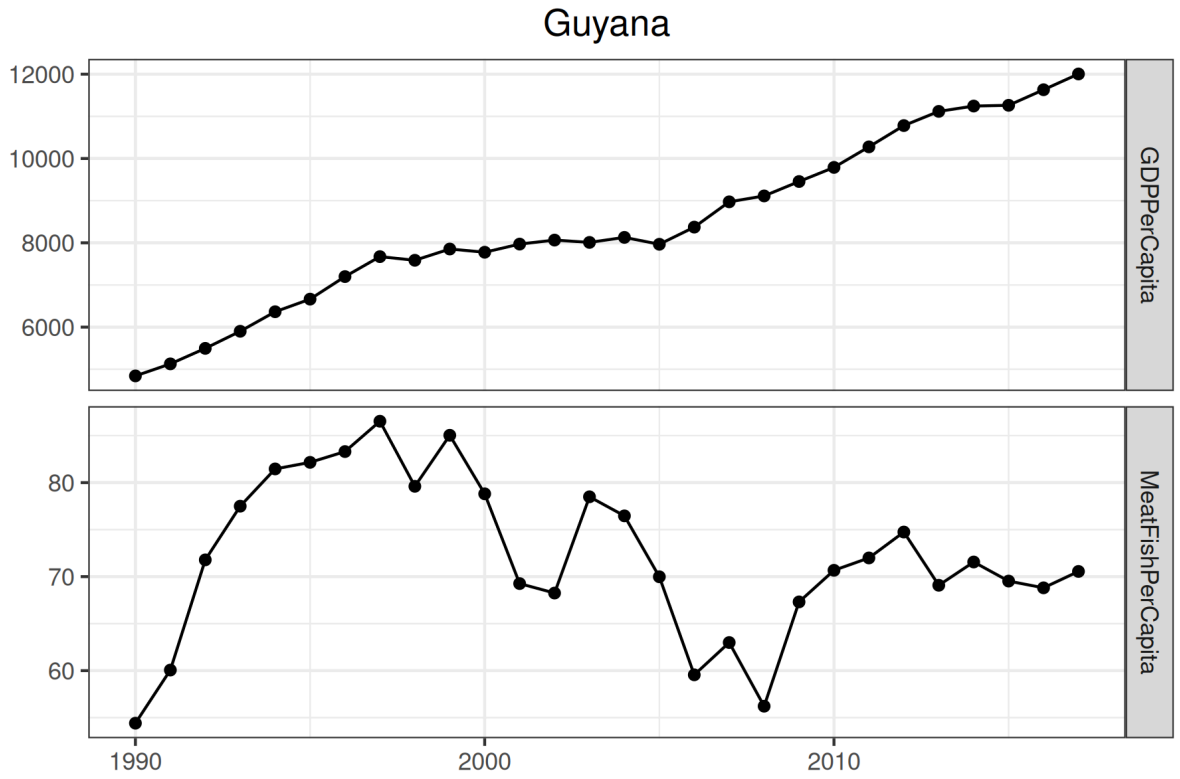
1990
2000
2010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8000
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2000
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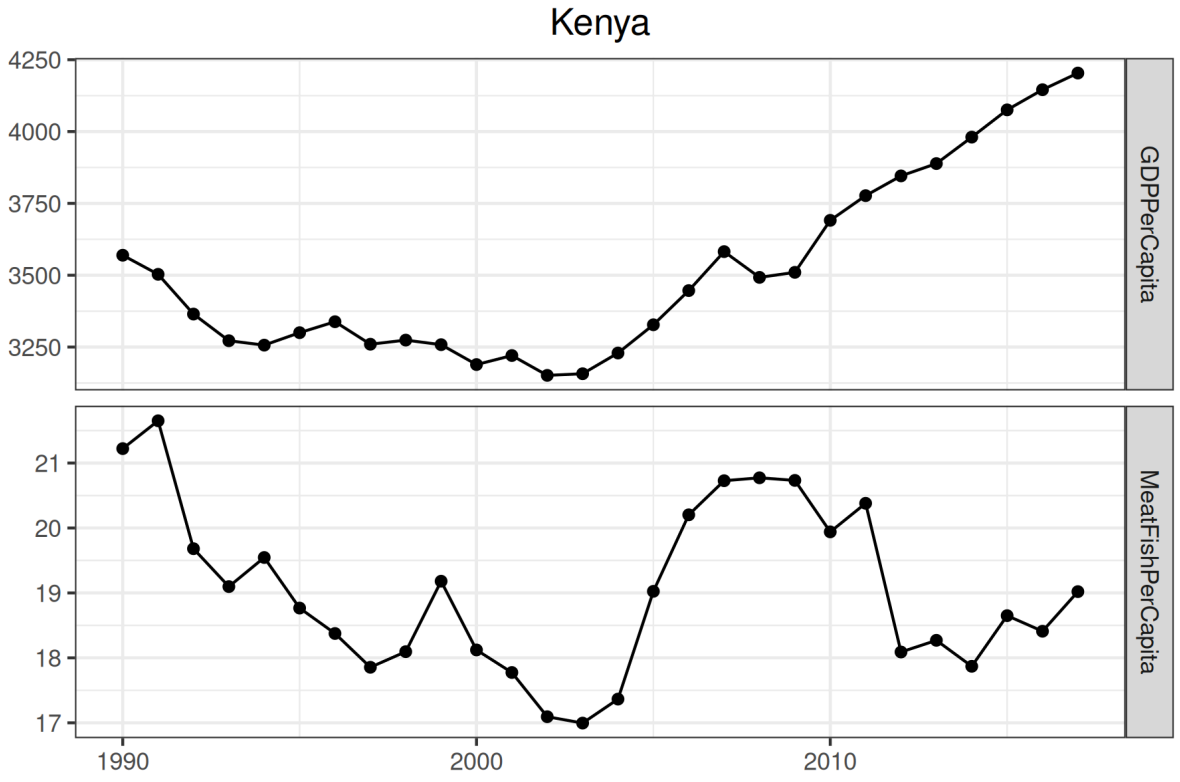
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3750
3500
3250
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20
19
18
17
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1990
2000
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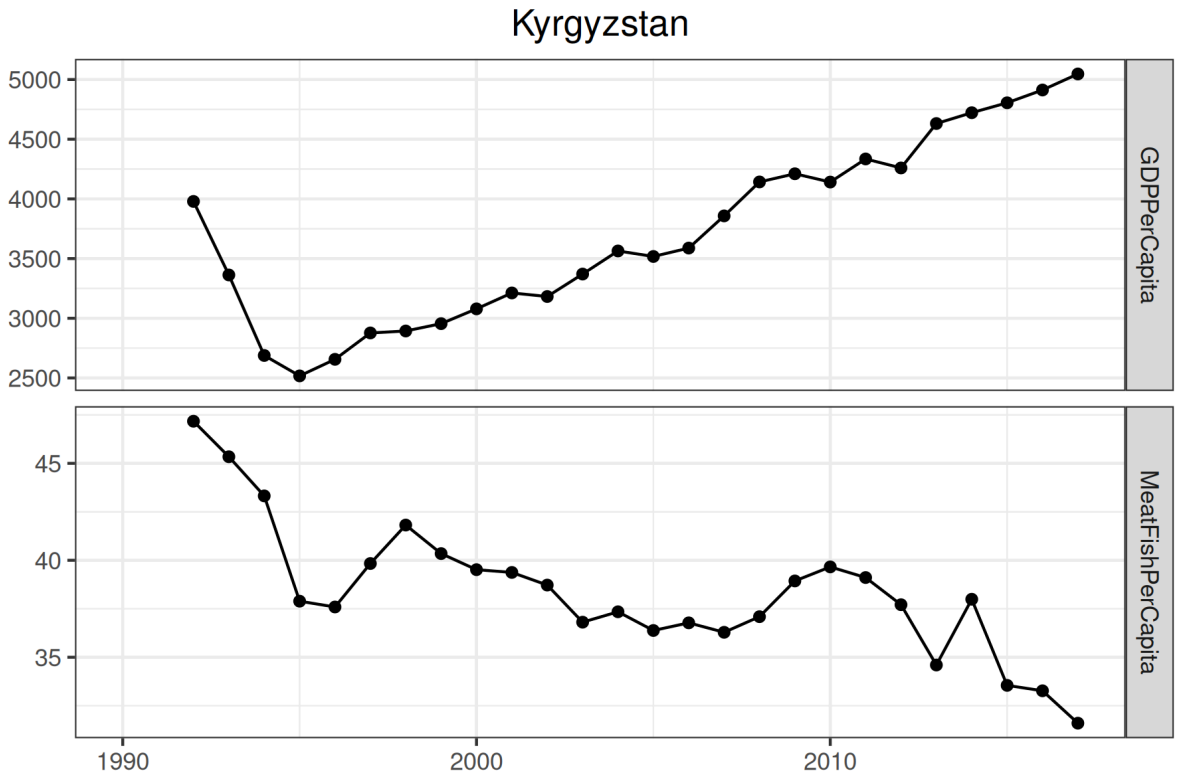
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1990
2000
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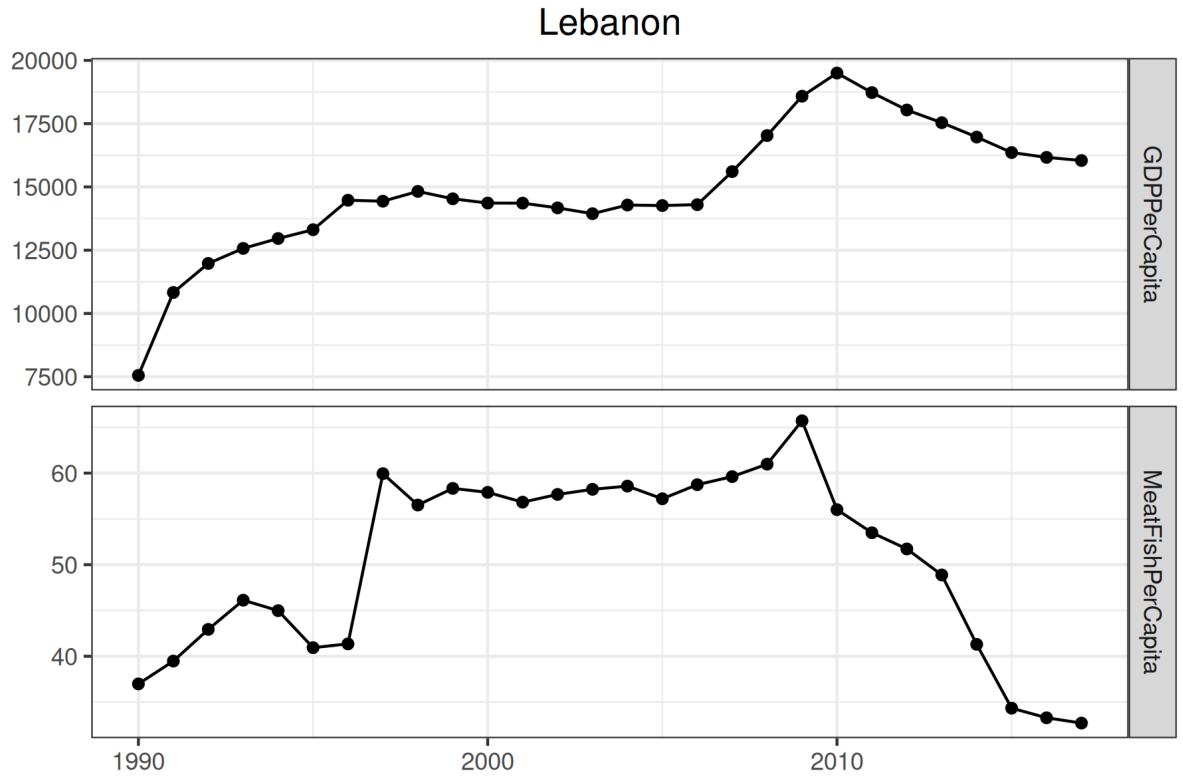
Lebanon
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17500
15000
12500
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7500
GDPPerCapita
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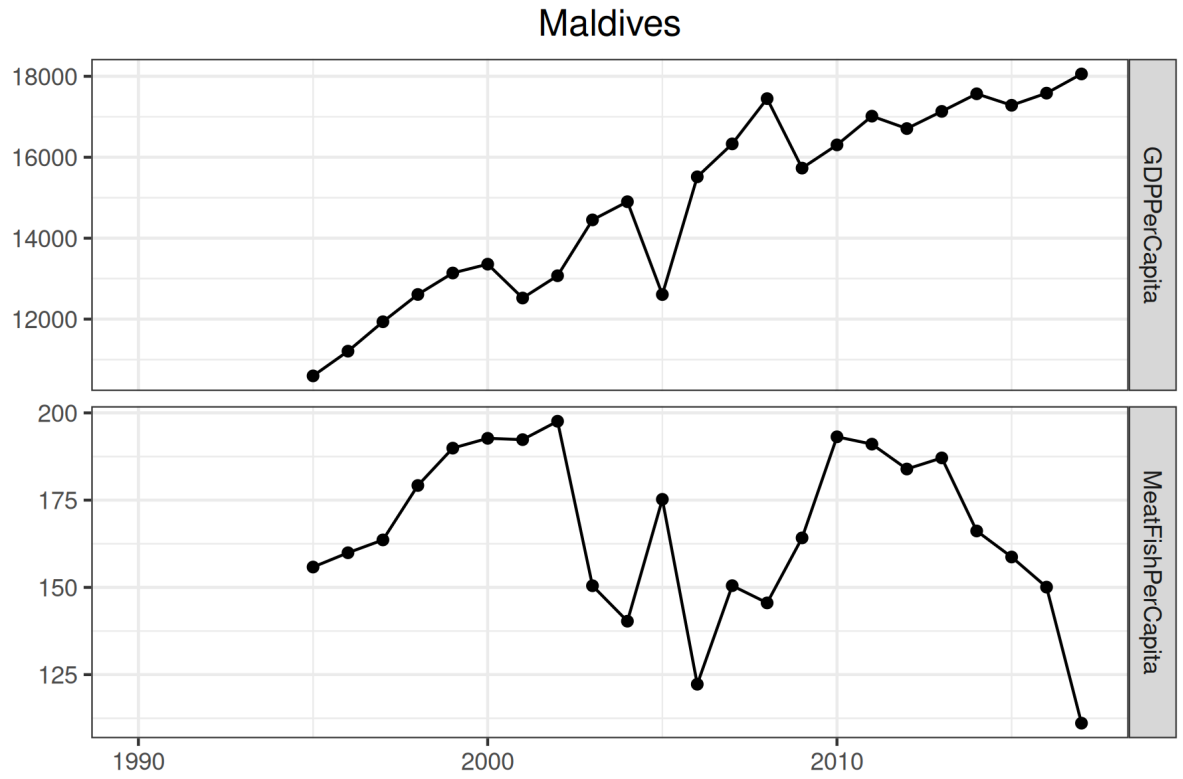
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18000
16000
14000
12000
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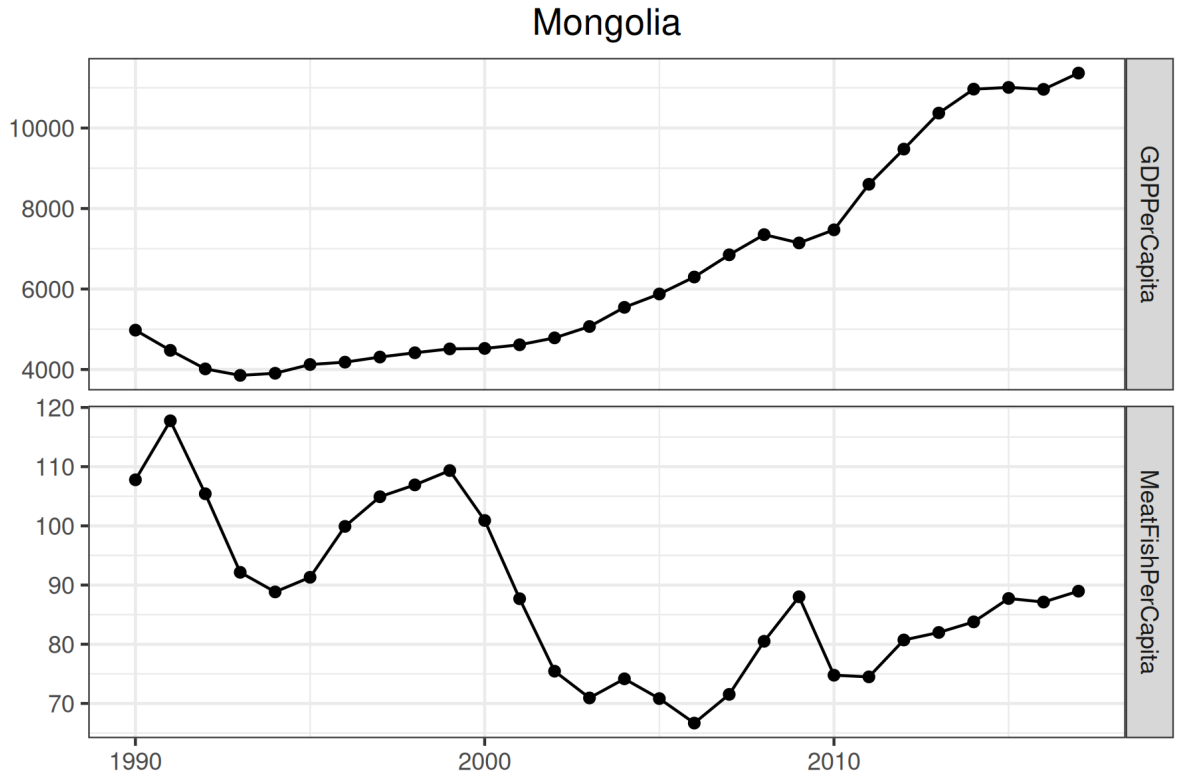
200
175
150
125
MeatFishPerCapita
1990
2000
2010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6000
4000
GDPPerCapita
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110
100
90
80
70
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1990
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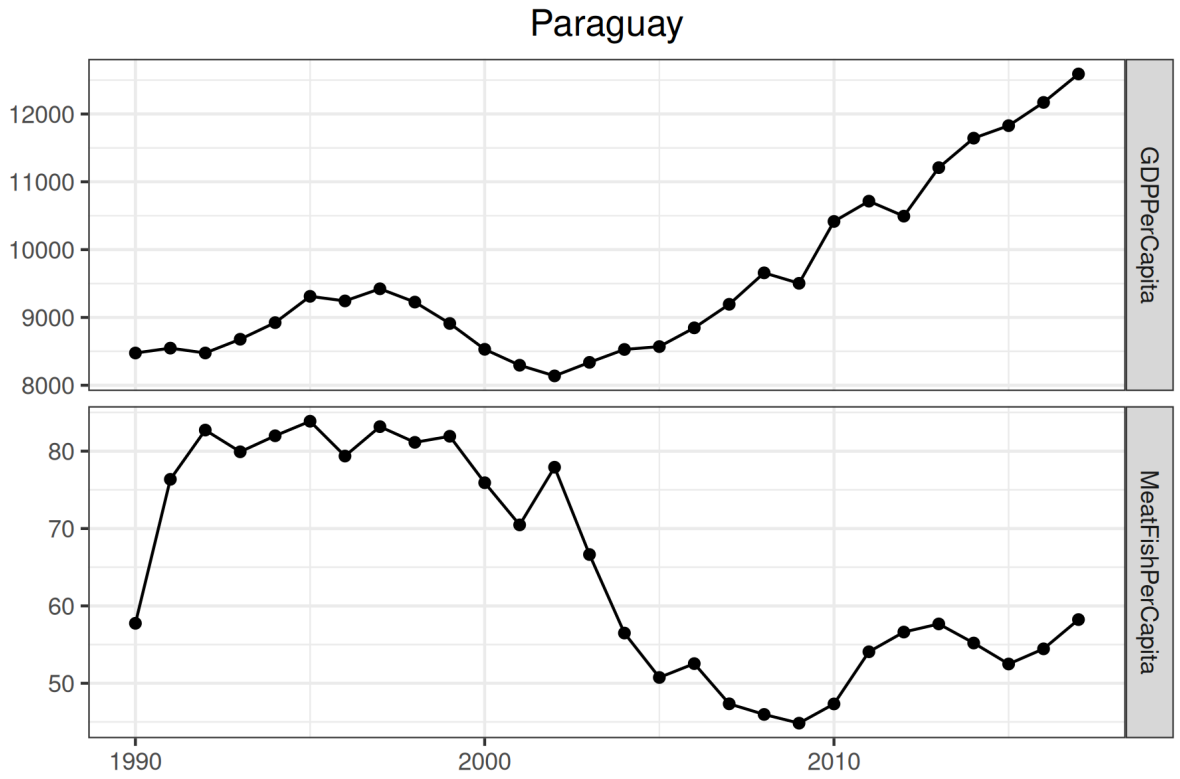
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11000
10000
9000
8000
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70
60
50
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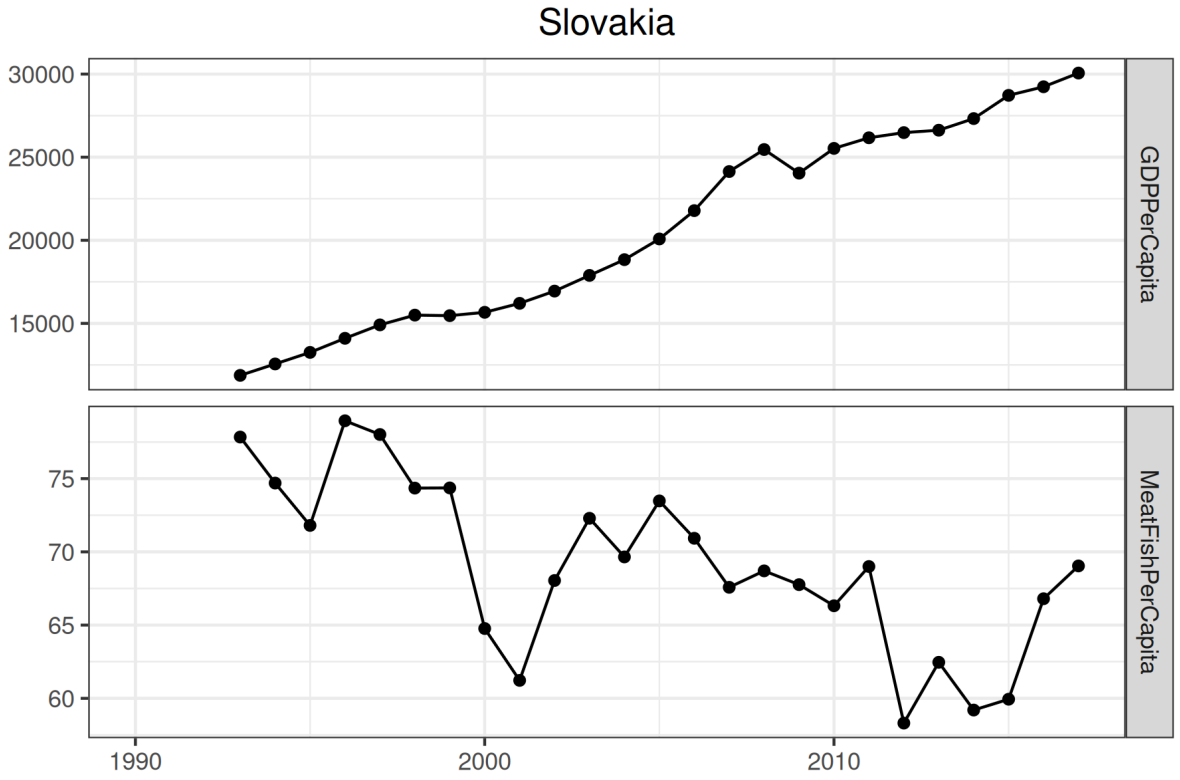
1990
2000
2010


Slovakia
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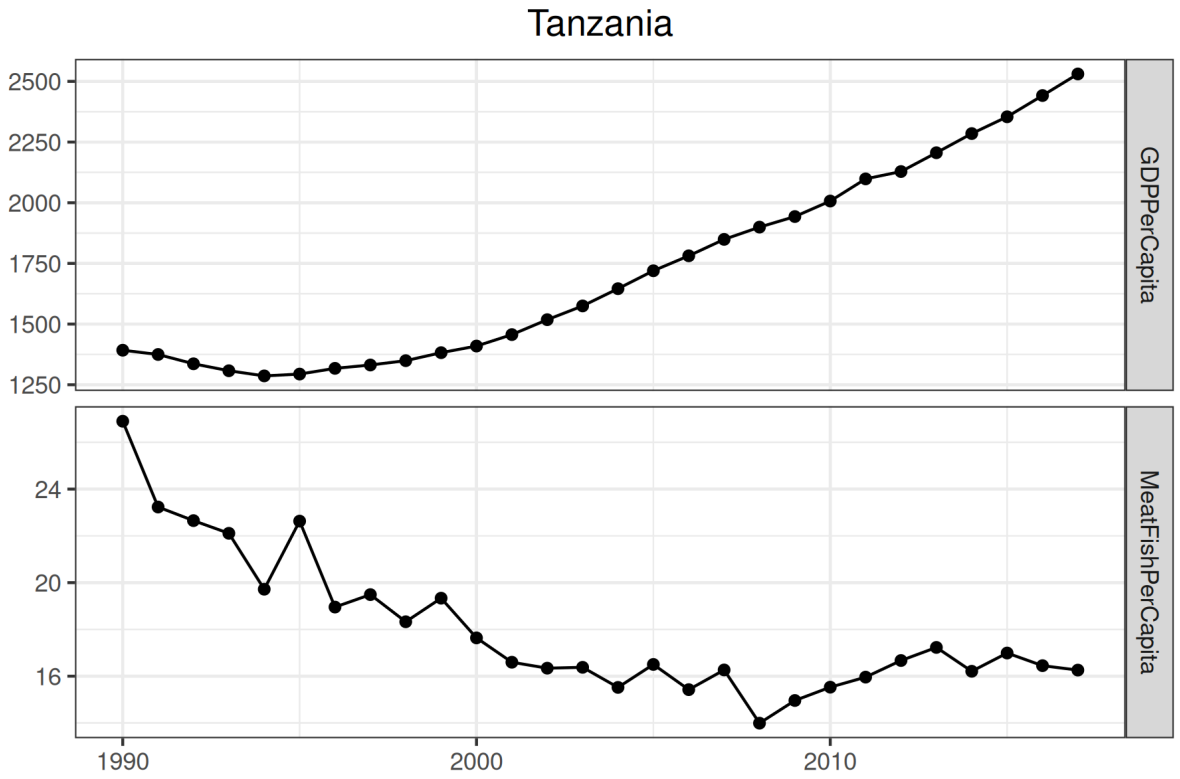
25000
20000
15000
GDPPerCapita
75
70
65
60
MeatFishPerCapita
1990
2000
2010


Tanzania
2500
2250
2000
1750
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1250
GDPPerCapita
24
20
16
MeatFishPerCapita
1990
2000
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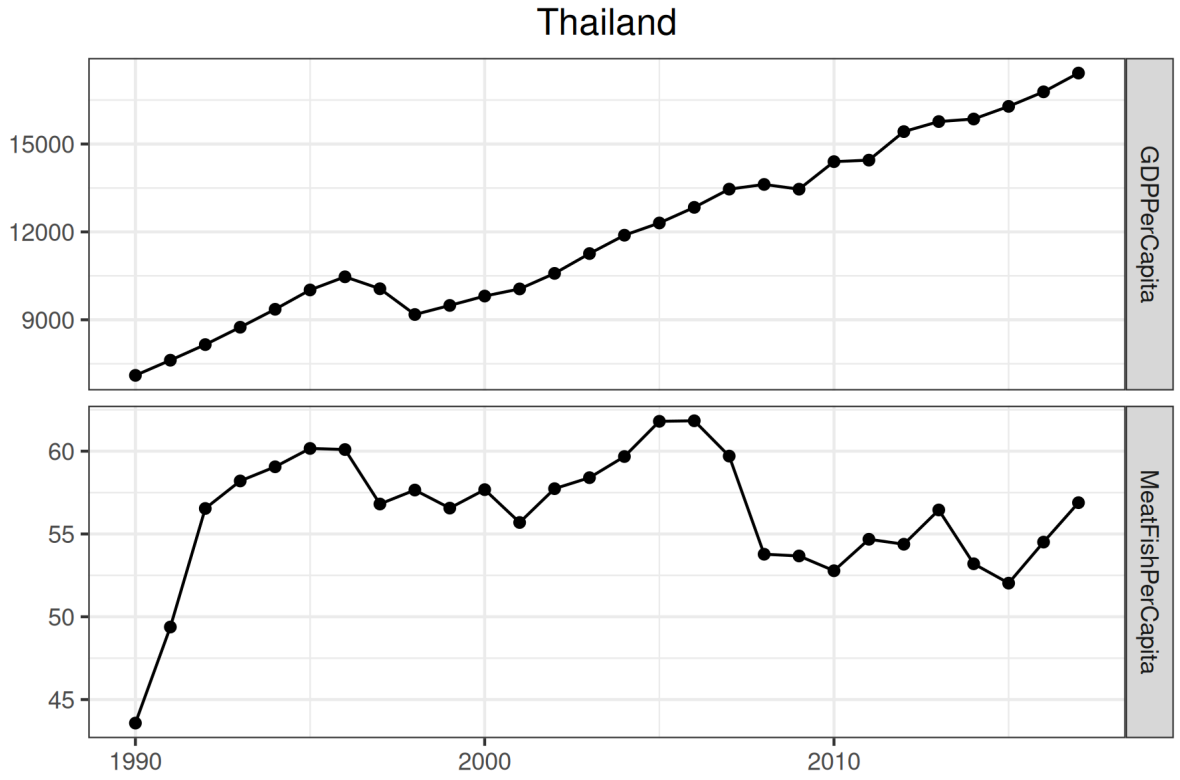
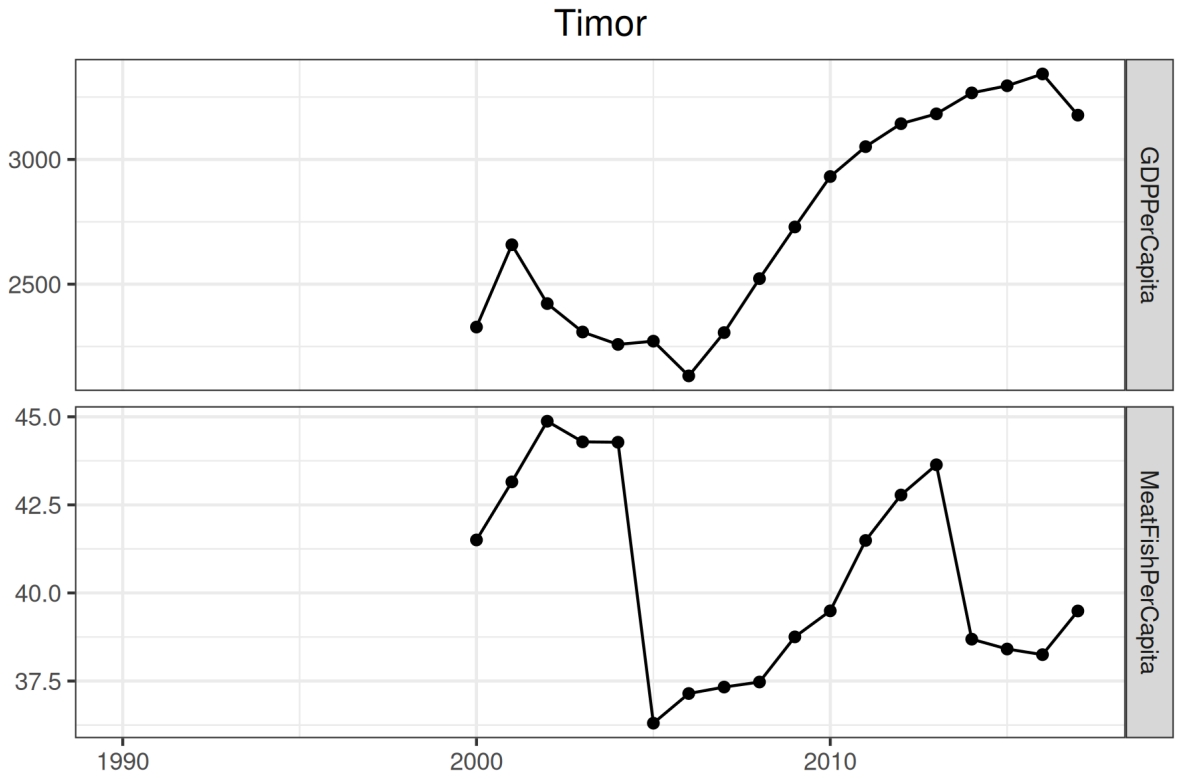
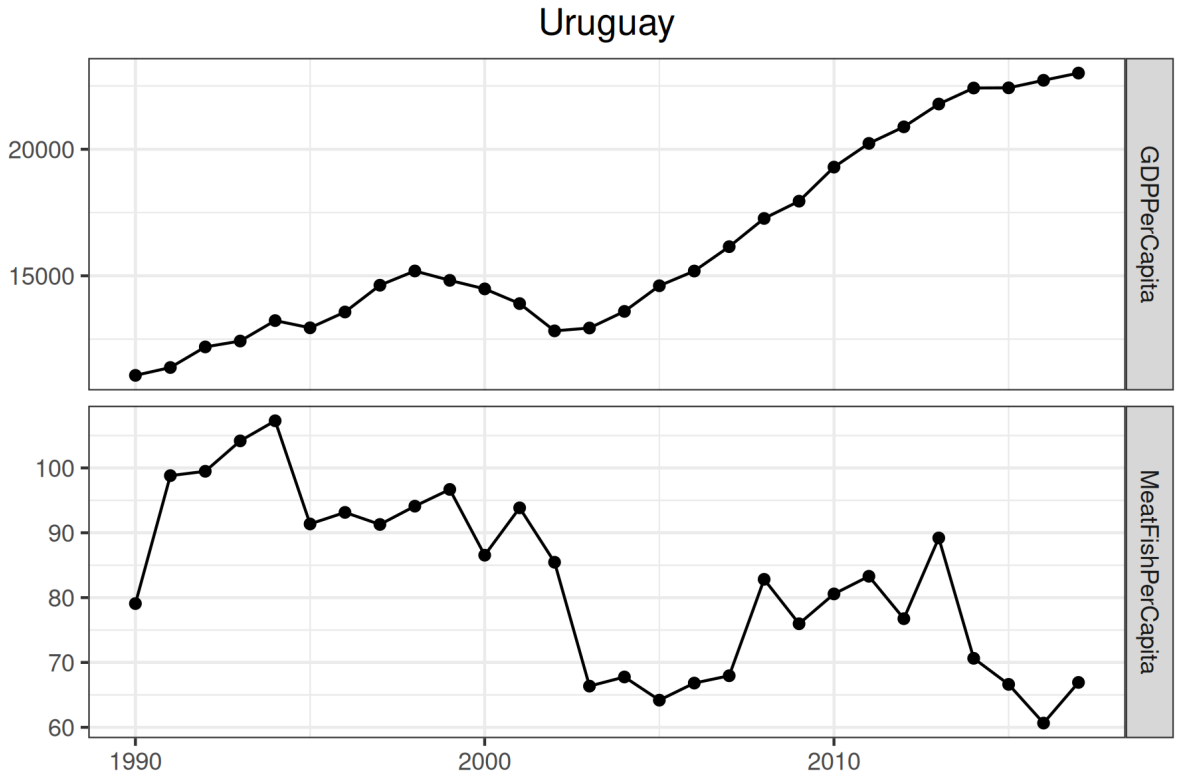
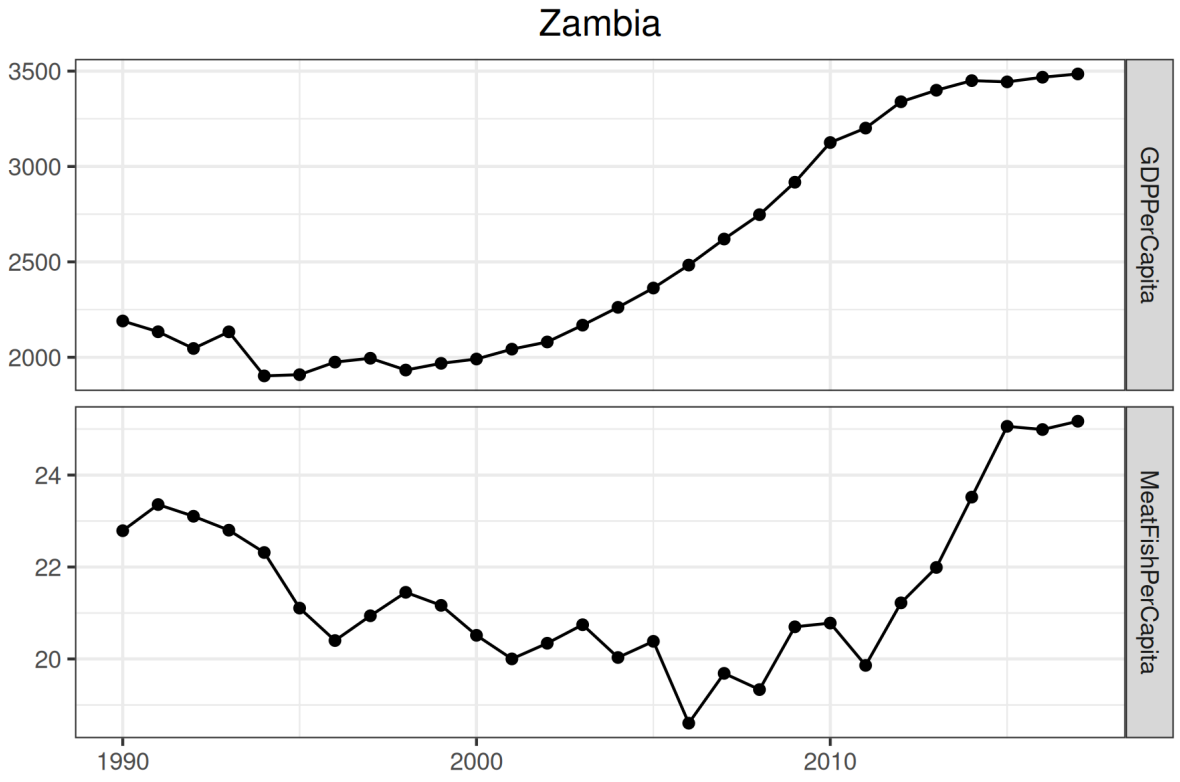

Thailand
15000
12000
9000
GDPPerCapita
60
55
50
45
MeatFishPerCapita
1990
2000
2010


Timor
3000
2500
GDPPerCapita
45.0
42.5
40.0
37.5
MeatFishPerCapita
1990
2000
2010


Uruguay
20000
15000
GDPPerCapita
100
90
80
70
60
MeatFishPerCapita
1990
2000
2010


Zambia
3500
3000
2500
2000
GDPPerCapita
24
22
20
MeatFishPerCapita
1990
2000
2010

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