

China's Meat Consumption:  
An Income Elasticity Analysis and Long-Term Projections

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## An Income Elasticity Analysis and Long-Term Projections

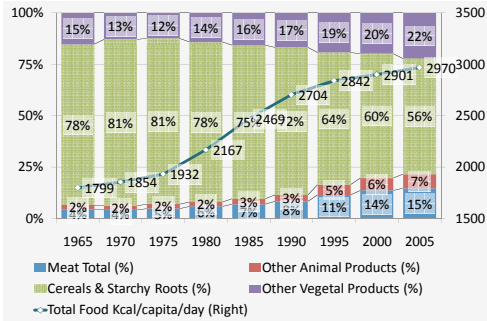
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### Introduction

Bennett (1941) suggests that the ratio of cereal-potato calories to total food calories is itself a rough (inverse) index of income status, and a rougher index of quality diet. In the light of what is called the Bennett's law, China (Mainland China + Hong Kong + Macau)'s per capita income growth as well as population growth and urbanization fuel the increase in meat consumption per capita and in total (Figures 1, 2, 3). During the half century, China's per capita real GDP (constant US dollar in 2000) increased 14.3 times and its total population 1.9 times.

Figure 1. China's Ratio of Meat Calories to Total Food Calories (1965-2005)

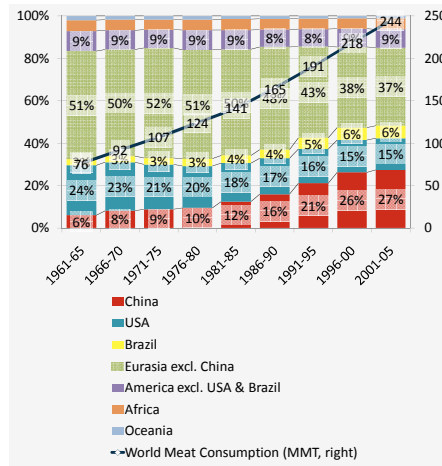


Notes: 1. China = Mainland China + Hong Kong + Macau.  
2. Meat = Bovine Meat + Mutton & Goat Meat + Pig Meat + Poultry Meat + Other Meat.  
3. Other Animal Products include offals, animal fats, eggs, milk, aquatic products.  
4. Other Vegetal Products include sugar crops, sugar & sweeteners, honey, pulses, tree nuts, oilcrops, vegetable oils, vegetables, fruits, stimulants, spices, alcoholic beverages.  
Source: FAOSTAT and authors' calculation.

### Objectives

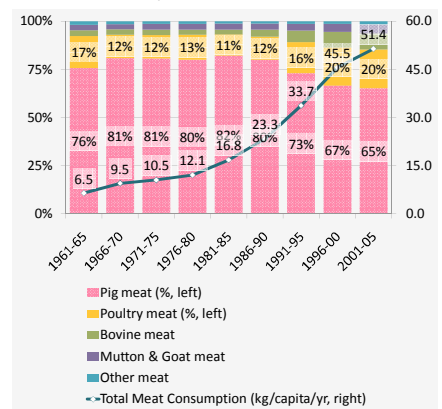
- 1) to estimate the long-term income elasticity of demand for meat by commodity (pig meat, poultry meat, bovine meat, and mutton & goat meat) in China and discuss the differences;
- 2) to project the long range meat consumption by commodity through 2030 in China; and
- 3) to discuss the policy and business implications regarding China's livestock industry and international feed grain and oilseeds markets.

Figure 2. Shifts of Meat<sup>1</sup> Consumption Quantity<sup>2</sup> Share of China<sup>3</sup>, USA, Brazil and Continents



Notes: 1. Meat = Bovine Meat + Mutton & Goat Meat + Pig Meat + Poultry Meat + Other Meat.  
2. Domestic supply quantity for food (million metric tons).  
3. China = Mainland China + Hong Kong + Macau.  
Source: FAOSTAT and authors' calculation.

Figure 3. China's Meat Consumption and Its Composition (1961-2005)



Notes. Meat Consumption = Domestic Meat Supply for Food / Population. Carcass retail weight loss is not considered.  
Source: FAOSTAT and authors' calculation.

### Methods

We deal with time series of China's domestic meat supply quantities for food (in metric tons) as meat consumption from 1961 to 2008. We employ the concept of income elasticity of demand using the per capita meat consumption and per capita real GDP. Data sources are FAOSTAT (FAO) and WDI Online (World Bank).

Vector Error Correction Model (VECM) is employed to estimate the cointegrating equations or long-term income elasticities. Gonzalo (1994) shows that Johansen's (1988) maximum likelihood approach clearly has better properties. Following Johansen (1995), the trend parameters are either set to zero or unrestricted to improve fitness. The damped-trend linear exponential smoothing model (Gardner and McKenzie, 1985; Gardner, 1985) is applied to estimate per capita GDP beforehand. Given the estimated income elasticities and per capita income, China's meat consumption quantities are projected using a recursive form through 2030.

### Results, Projections, and Discussion

-With respect to income increase, pig meat consumption is inelastic (0.151), mutton & goat meat and poultry meat are rather unity (0.882 and 1.057), but bovine meat consumption is elastic (1.560) (Table 1).

- As GDP grows annually at 4.9% in 2010-20 and 2.8% in 2020-30, total meat consumption increases at 3.2% and 2.0%, respectively, and reaches 136 mil. metric tons in 2030 (Table 2).

- China's per capita meat consumption (54 kg/ca/yr in 2006-07) is already above the world average (41) and will exceed the current Brazil's per capita meat consumption (81) in 2020s.

- China is a top importer of feed crop (soybean) and now meat importer (Table 3).

- As food policy, China needs to consider self-sufficiency and distribution of protein foods.

- International meat and feed crop markets will be affected by China's livestock industry.

Table 1. Long-term Income Elasticity of Meat Consumption in China

| Commodity     | Elasticity | Std. Err. | Log L   | # of lags | Period    | # of Obs. |
|---------------|------------|-----------|---------|-----------|-----------|-----------|
| Pig meat      | 0.151      | 0.048***  | 169.556 | 3         | 1964-2008 | 45        |
| Poultry meat  | 1.057      | 0.087***  | 168.582 | 3         | 1964-2008 | 45        |
| Bovine meat   | 1.560      | 0.143***  | 154.035 | 3         | 1964-2008 | 45        |
| Mutton & Goat | 0.882      | 0.045***  | 169.507 | 3         | 1964-2008 | 45        |
| Other meat    | 0.944      | 0.088***  | 132.126 | 3         | 1964-2008 | 45        |

Note. \*\*\*Denotes significant at 1%.  
Source: Estimation by authors.

Table 2. China's Meat Consumption: Projection Summary

|  | 1999/01 | 2010  | 2020  | 2030  |
|--|---------|-------|-------|-------|
| Meat Consumption, Total (MMT)          | 62.6    | 81.6  | 111.8 | 136.3 |
| -- Pig meat                            | 41.0    | 48.7  | 54.9  | 58.3  |
| -- Poultry meat                        | 12.9    | 19.0  | 31.6  | 42.0  |
| -- Bovine meat                         | 5.2     | 7.7   | 15.8  | 23.8  |
| -- Mutton & Goat meat                  | 2.7     | 4.4   | 6.7   | 8.5   |
| -- Other meat                          | 0.8     | 1.8   | 2.8   | 3.6   |
| Per Capita Meat Cons. (kg/capita/year) | 49.2    | 59.9  | 77.7  | 92.6  |
| -- Pig meat                            | 32.2    | 35.8  | 38.2  | 39.6  |
| -- Poultry meat                        | 10.1    | 14.0  | 21.9  | 28.6  |
| -- Bovine meat                         | 4.1     | 5.6   | 11.0  | 16.2  |
| -- Mutton & Goat meat                  | 2.1     | 3.2   | 4.7   | 5.8   |
| -- Other meat                          | 0.7     | 1.3   | 1.9   | 2.4   |
| GDP (billion constant 2000 USD)        | 1,372   | 3,276 | 5,302 | 6,956 |
| Per Capita GDP (cons. 2000 USD/capita) | 1,077   | 2,406 | 3,683 | 4,728 |
| Population, Total (million people)     | 1,274   | 1,362 | 1,439 | 1,471 |

|                                      | 1999/01-2010 | 2010-20 | 2020-30 |
|--------------------------------------|--------------|---------|---------|
| Meat Consumption, Total (CAGR %)     | 2.7%         | 3.2%    | 2.0%    |
| -- Pig meat                          | 1.8%         | 1.2%    | 0.6%    |
| -- Poultry meat                      | 4.0%         | 5.2%    | 2.9%    |
| -- Bovine meat                       | 4.0%         | 7.5%    | 4.2%    |
| -- Mutton & Goat meat                | 5.0%         | 4.4%    | 2.5%    |
| -- Other meat                        | 7.6%         | 4.7%    | 2.6%    |
| Per Capita Meat Consumption (CAGR %) | 2.0%         | 2.6%    | 1.8%    |
| -- Pig meat                          | 1.1%         | 0.6%    | 0.4%    |
| -- Poultry meat                      | 3.3%         | 4.6%    | 2.7%    |
| -- Bovine meat                       | 3.3%         | 6.9%    | 4.0%    |
| -- Mutton & Goat meat                | 4.3%         | 3.8%    | 2.2%    |
| -- Other meat                        | 6.9%         | 4.1%    | 2.4%    |
| Gross Domestic Product (CAGR %)      | 9.1%         | 4.9%    | 2.8%    |
| Per Capita GDP (CAGR %)              | 8.4%         | 4.4%    | 2.5%    |
| Population, Total (CAGR %)           | 0.7%         | 0.6%    | 0.2%    |

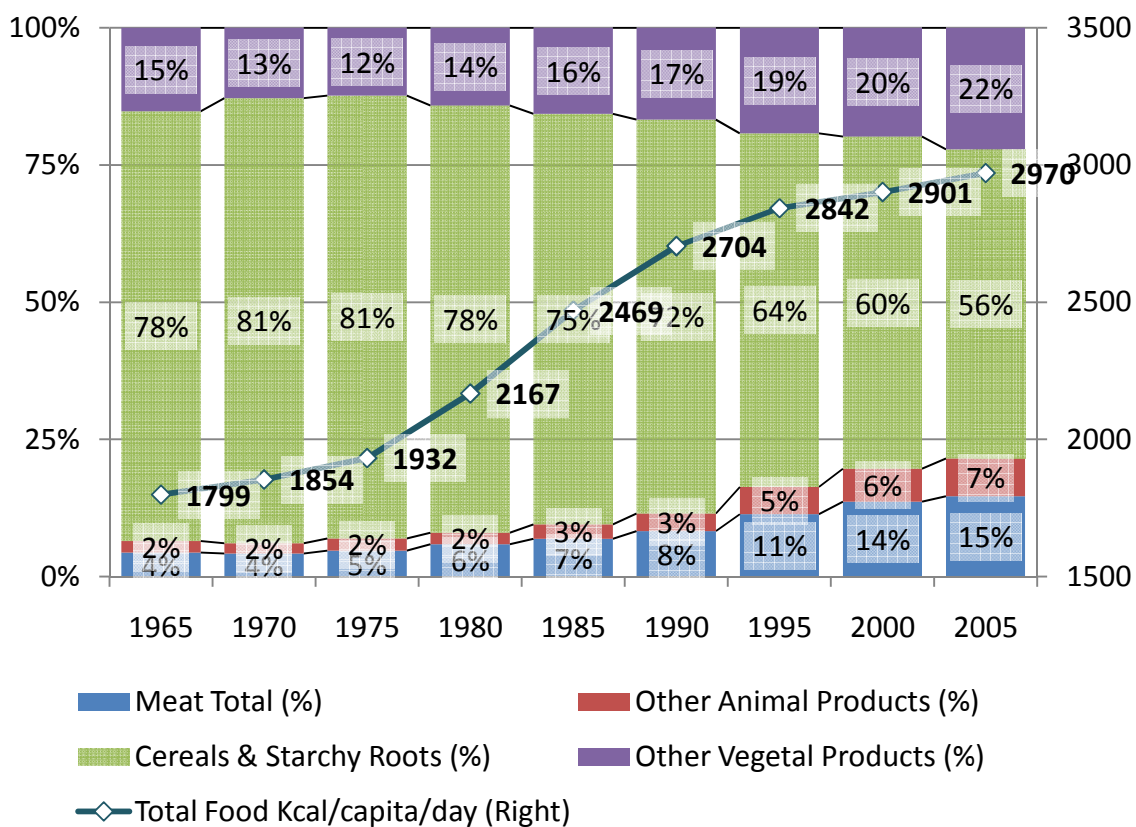
Note. 1. Projection starts from 2009.  
2. CAGR = Compound Annual Growth Rate.  
Sources: FAOSTAT, World Bank WDI, and estimation by authors.

Table 3. Meat Supply Balances in China, USA, Brazil & India (2006-07 year average)

| Element                            | World | China | USA   | Brazil | India |
|------------------------------------|-------|-------|-------|--------|-------|
| Production (million metric tons)   | 269.9 | 71.6  | 41.5  | 21.1   | 6.4   |
| Net Import (million metric tons)   | -     | 0.7   | -3.0  | -5.8   | -0.5  |
| Dom. Supply (million metric tons)  | 269.9 | 72.3  | 38.5  | 15.3   | 5.9   |
| Per Capita Supply (kg/capita/year) | 40.7  | 54.2  | 125.5 | 80.8   | 5.1   |
| Population, Total (million people) | 6,631 | 1,332 | 307   | 189    | 1,156 |

Source: FAOSTAT and authors' calculation.

Figure 1. China's Ratio of Meat Calories to Total Food Calories (1965-2005)



Notes: 1. China = Mainland China + Hong Kong + Macau.

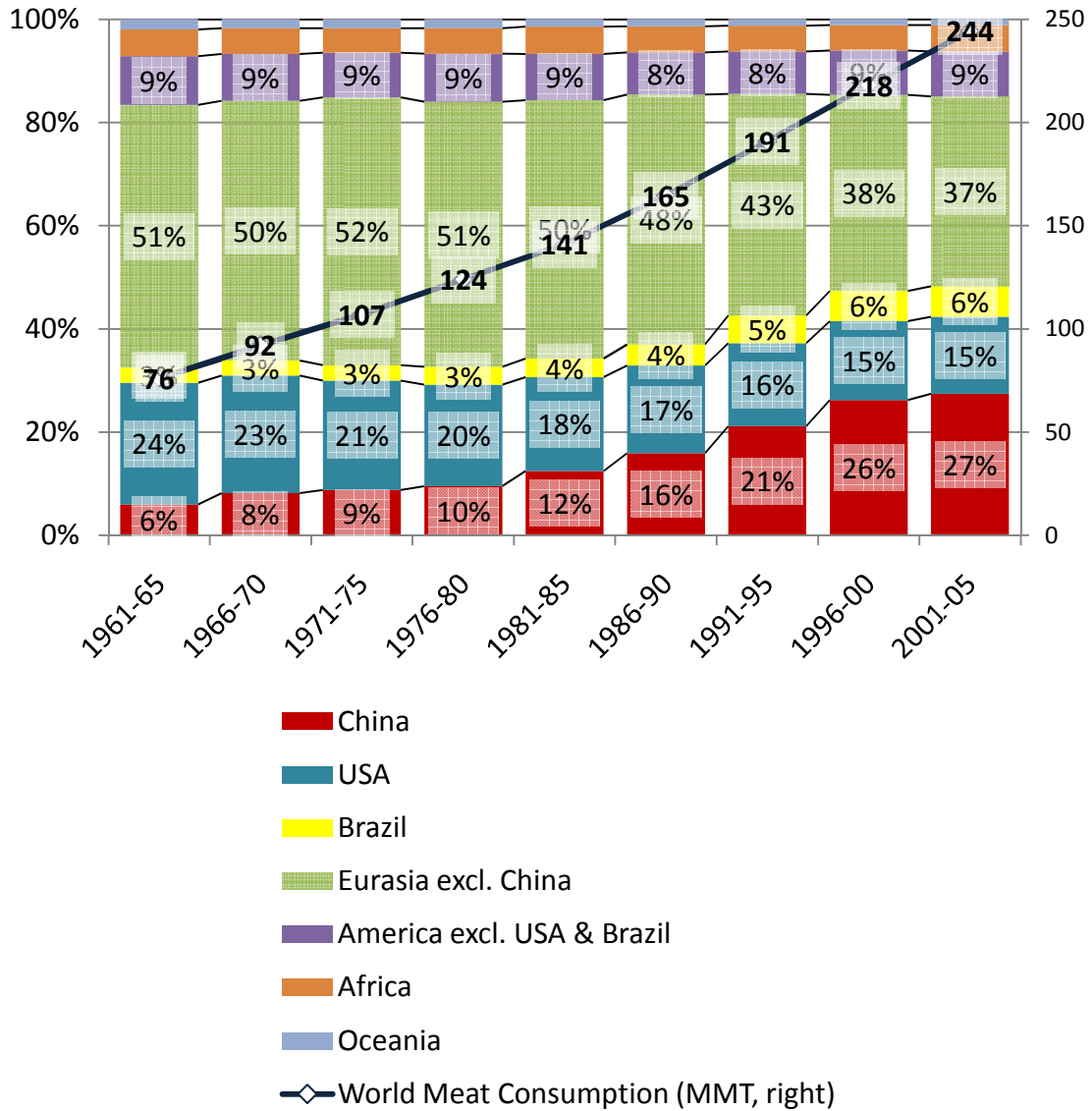
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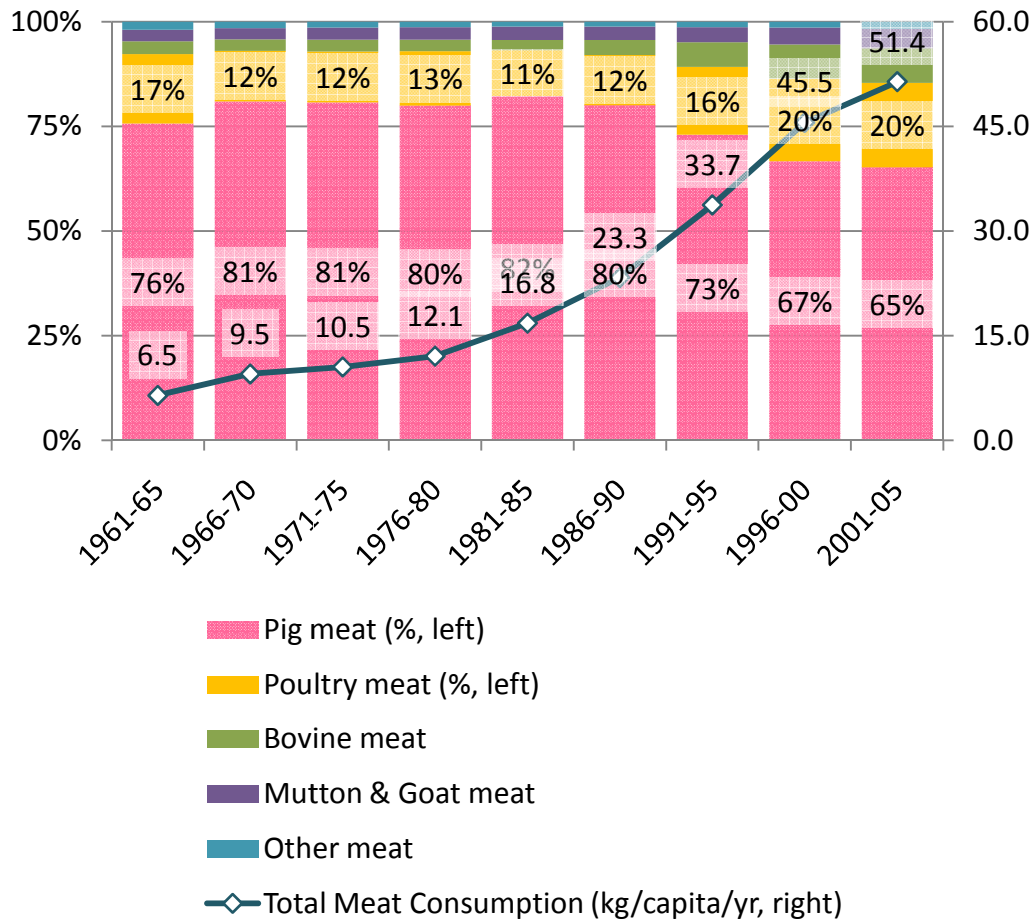
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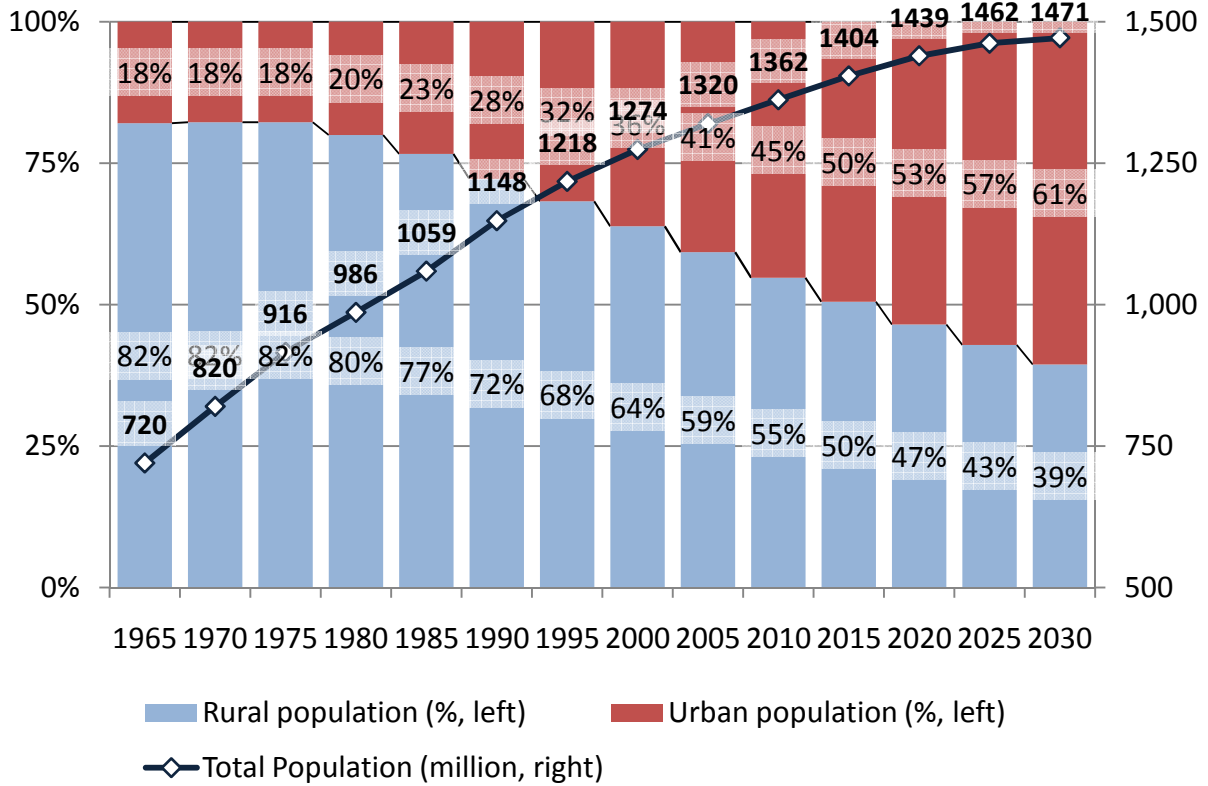
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Notes. Meat Consumption = Domestic Meat Supply for Food / Population. Carcass retail weight loss is not considered.

Source: FAOSTAT and authors' calculation.

Figure 4. China's Population Shift from Rural to Urban (1965-2030)



Source: FAOSTAT and authors' calculation.

Table 1. Long-term Income Elasticity of Meat Consumption in China

| commodity     | Elasticity | Std. Err. |     | Cons.  | Std. Err. | Log L   | # of lags | Period     | # of Obs. |
|---------------|------------|-----------|-----|--------|-----------|---------|-----------|------------|-----------|
| Pig meat      | 0.151      | 0.048     | *** | -      | -         | 169.556 | 3         | 1964 -2008 | 45        |
| Poultry meat  | 1.057      | 0.087     | *** | -4.706 | -         | 168.582 | 3         | 1964 -2008 | 45        |
| Bovine meat   | 1.560      | 0.143     | *** | -8.572 | -         | 154.035 | 3         | 1964 -2008 | 45        |
| Mutton & Goat | 0.882      | 0.045     | *** | -5.761 | -         | 169.507 | 3         | 1964 -2008 | 45        |
| Other meat    | 0.944      | 0.088     | *** | -6.566 | -         | 132.126 | 3         | 1964 -2008 | 45        |

Note. \*\*\*Denotes significant at 1%.

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|   | 1999/01-2010 | 2010-20 | 2020-30 |
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| Meat Consumption, Total (CAGR <sup>2</sup> %) | 2.7%         | 3.2%    | 2.0%    |
| -- Pig meat                                   | 1.8%         | 1.2%    | 0.6%    |
| -- Poultry meat                               | 4.0%         | 5.2%    | 2.9%    |
| -- Bovine meat                                | 4.0%         | 7.5%    | 4.2%    |
| -- Mutton & Goat meat                         | 5.0%         | 4.4%    | 2.5%    |
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| Per Capita Meat Consumption (CAGR %)          | 2.0%         | 2.6%    | 1.8%    |
| -- Pig meat                                   | 1.1%         | 0.6%    | 0.4%    |
| -- Poultry meat                               | 3.3%         | 4.6%    | 2.7%    |
| -- Bovine meat                                | 3.3%         | 6.9%    | 4.0%    |
| -- Mutton & Goat meat                         | 4.3%         | 3.8%    | 2.2%    |
| -- Other meat                                 | 6.9%         | 4.1%    | 2.4%    |
| Gross Domestic Product (CAGR %)               | 9.1%         | 4.9%    | 2.8%    |
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Note. 1. Projection starts from 2009.

2. Compound Annual Growth Rate.

Sources: FAOSTAT, World Bank WDI, and estimation by authors.



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| Population, Total (million people)                 | 6,631 | 1,332 | 307   | 189    | 1,156 |

Notes: 1. Net Import = Import – Export.

2. Domestic Supply = Production + Net Import.

3. Per Capita Supply = Domestic Supply / Population.

Source: FAOSTAT and authors' calculation.

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