A stochastic frontier analysis approach for estimating market power in the major U.S. meat export markets

Panagiotou, Dimitrios and Stavrakoudis, Athanassios

University of Ioannina, Department of Economics

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Abstract

The present study estimates the degree of market power in the major U.S. beef and pork export destinations. The recently developed stochastic frontier (SF) estimator is used. Estimations of market and time specific Lerner indices are provided. Balanced panel data between 1980-2011 were employed. The average Lerner index is 39% for the U.S. beef exports and is the highest in the markets of ASEAN, Hong Kong/China, Japan, South Korea and Taiwan. For the U.S. pork exports, the average Lerner index is 16% and is the highest in the markets of Mexico and Taiwan.

Keywords: Stochastic frontier; market power; U.S. meat exports.
JEL classification: D21, L22, L66.

1 Introduction

In January of 2018 the U.S. government announced a 25% tariff on steel imports and a 10% tariff on aluminum imports from China. Later that year, pork and beef producers in the U.S. were hit with a retaliatory 25% tariff on their China bound exports. More specifically, the tariff on pork exports was implemented in April of 2018 and the tariff on beef exports was implemented in June of 2018. In addition, Mexico, Canada and the European Union have threatened to add their own tariffs on U.S. meat products.

China, Mexico and Canada are among the top destinations for the U.S. meat exports. The aforementioned countries, along with Japan and South Korea, account for more than eighty percent of the U.S. meat exports, in terms of volume and value (U.S. Meat Export Federation, 2017). Given the fact that the United States of America is among the world's largest pork and beef exporters, the competitive conditions in the major U.S. meat export markets are of significant importance.

United States is the world's largest pork exporter with a global market share approaching 30% (United States Department of Agriculture – Economic Research Service, 2017). One in every 3.4 pounds of pork traded in the world will originate from the United States (U.S. Meat Export Federation, 2017). Pork exports account for more than 20% of domestic U.S. pork production. Concurrently, U.S. is the world's fourth largest beef exporter with a global market share close to 12% (ERS-USDA, 2017). Beef exports represent more than 10% of domestic U.S. beef production. The aforementioned facts constitute the United States of America as one of the most important players in the global meat market.

In the last 30 years U.S. pork exports have grown from 86 million pounds carcass weight equivalent in 1986 to 4.858 billion pounds in 2014, an increase of 5649%. During the same time period the value of pork and pork byproduct exports has increased from $1.97 per hog slaughtered to $62.45 per head slaughtered. As a consequence, the total income of all U.S. pork producers has been improved by

$9 billion over the last 30 years due to the increase in net exports. For the year 2016, U.S. exported 2.31 billion metric tones (MT=2204.6 lbs) of pork and pork variety meat, exhibiting an increase of 8% in volume (2.31 million mt) and 7% in value ($5.94 billion) compared with the previous year (U.S. Meat Export Federation, 2017). The top markets for the U.S. pork exports in terms of value and volume are Japan (destination for about one-third of U.S. exports), Mexico, Canada, South Korea and China. These markets account for almost 90% of the U.S. pork exports. Combined, the U.S., the European Union, Canada and Brazil account for nearly 92% of world pork exports.

U.S. beef shipments to foreign countries have grown more than 80% in the last 30 years, while domestic beef consumption has increased only by 14%. According to Panagiotou (2008), a one percent increase in beef exports leads to a 1.6% increase in fed cattle price. With beef exports at 12% and at a base cattle price of $85/cwt, this translates into about a $20/cwt added value. For the year 2016, US exported 1.18 billion MT of beef and beef variety meat. Annual total beef shipments were valued at $6.34 billion, up 0.6% from 2015. From January through July of 2017, exports have increased 11% in volume (711,364 mt) and 15% in value ($3.97 billion), compared to the first seven months of 2016 (United States Department of Agriculture – Foreign Agricultural Service, 2017). On a volume and value basis, the top export markets for US beef are Japan, Canada, Mexico, and Hong Kong, accounting for more than 80% of the US beef exports (U.S. Meat Export Federation, 2017).

Despite the importance of U.S.beef and pork exports, domestically and globally, the literature has not paid has not paid enough attention on the competitive conditions in each one of the major U.S. beef and pork export markets. There are studies in the relevant literature (Arnade et al., 1998; Miljkovic et al., 2003) that measure the degree of market power in the U.S. meat exports but at aggregate level, both for the meat product (beef and pork together) as well as for the destination of exports (all export markets together). The only exception are U.S. beef and pork exports

to Japan.

Japan has been the most important export market for both U.S. beef and pork products. The 1995-1998 depreciation in the Japanese yen by 39% reduced U.S. slaughter steer and hog prices by $1.29 per cwt and $0.99 per cwt, respectively, while the 1994-1998 reduction in tariffs by 14% increased slaughter steer and hog prices by $0.49 per cwt and $0.33 per cwt, respectively (Miljkovic et al., 2002). Although having a significant market share in the Japanese beef market, US does not seem to exercise significant market power (Reed and Iswariyardi, 2001; Reed and Saghaian, 2004). On the other hand, U.S. appears to have market power in the Japanese pork market (Felt et al., 2011). U.S. NAFTA partners are also important markets for the U.S. beef and pork exports (USDA, 2017). Empirical findings indicate that increases in meat expenditures in Canada and Mexico are expected to significantly raise the demand for U.S. meats affecting this way exporters' welfare (Henneberry and Mutondo, 2009). One of the studies on pork trade, calculates the effect of imports and exports on the price of hogs (Plain, Ron, 2014). The author used a demand elasticity of -0.3, and assumed a 1% increase (decrease) in net exports. The result would be 3.33% rise (fall) in hog prices.

Apart from the significant global market share of the U.S. beef and pork exports, U.S. meat exporters have an additional advantage due to the superior quality of their products. The combination of genetic improvement, the additional days of feeding and the grain fed U.S. animals as opposed to grass fed livestock from most of the other major exporting countries, are some of the factors that contribute to the higher quality of the U.S. meat products. Thus, both U.S. beef and pork have quality advantages that can set the demand curve faced by U.S. meat exporters even more inelastic. The latter, along with the fact that United States is one of the most dominant players in meat exports worldwide, might lead to market power exertion by the U.S. exporters of beef and pork.[1]

[1]The present work concentrates on the measurement of the degree of market power exerted by the U.S. meat packers and does not account for bilateral oligopoly power.

Against this background, the objective of this study is to estimate the degree of market power in each one of the major U.S. meat export markets with the employment of the recently developed stochastic frontier (SF) estimation technique by Khumbhakar, Baardsen and Lien (2012).[2] In their original work, Kumbhakar et al. (2012) draw on the stochastic frontier methodology from the efficiency literature and propose a new method of market power estimation. The SF method treats mark-ups as deviations from an optimal marginal cost pricing frontier. This methodology has been applied to the U.S. food industry by Lopez et al. (2018), to the U.S. cattle industry by Panagiotou and Stavrakoudis (2017), and to the Brazilian milk market by Scalco et al. (2017).

Furthermore, there are two very recent studies that have utilized the stochastic frontier estimator of market power in the U.S. meat packing industry. The first study, under the title "A stochastic frontier estimator of the aggregate degree of market power exerted by the U.S. meat packing industry" by Panagiotou and Stavrakoudis (2018), employed a stochastic frontier estimator in order to measure the market power exerted by the U.S. meat packers (beef and pork meat in aggregate). The period of estimation was 1970-2011. The estimated degree of market power was 3.74%. The second study, under the title "Market Power Effects of the Livestock Mandatory Reporting Act in the U.S. Meat Industry: A Stochastic Frontier Approach under Uncertainty" by Panagiotou (2019), estimated the degree of market power in the U.S. beef and pork packing industries, for the period before (1970-2001), and after (2002-2010) the implementation of the Livestock Mandatory Reporting Act. The empirical findings reveal that the average degree of market power exerted in the U.S. beef packing was 5.268% for the period 1970-2001 and 3.829% for the time period 2002-2010. For the same time periods, the market power

[2]Vertically integrated agribusiness firms are able to exercise oligopoly power in the domestic and/or the export markets. The goal of the present study is to examine the exertion of oligopoly power in international meat export markets. Panagiotou and Stavrakoudis (2017, 2018) and Lopez et al. (2018) have employed the stochastic frontier methodology in order to obtain market power estimates for the domestic meat industry.

exerted by the U.S. pork packing industry was 4.317% and 3.530%, respectively.

One of the big advantages of the SF estimation approach is that it bypasses the estimation of demand and conduct needed in new empirical industrial organization (NEIO) models in order to measure the gap between price and marginal cost of production (Lopez et al., 2018). In the present study, where data for estimating demand for US meat exports by foreign countries would be hard to collect, the SF estimation technique is the most indicative in order to obtain market power estimates in each one of the meat export markets under examination.

The present study contributes to the literature from at least two viewpoints. First, it measures market power in each one of the most significant U.S. beef and pork export markets. Despite the fact that the United States is a major player in the global meat market, there are no prior studies that have attempted to do so. Secondly, for the estimation of market power in an export market, it employs the recently developed SF methodology which enables the researcher to estimate markups without having to estimate demand and conjectural variations elasticity, as is the case in the majority of the empirical studies in the relevant literature (NEIO). Furthermore, in contrast to traditional stochastic frontier analysis, the present study allows for the estimation of export market - and time - specific Lerner indices.

To the best of our knowledge, there has been no published work on the estimation of market power on all the major U.S. meat export markets.[3]

Section 2 presents the stochastic frontier estimator of the degree of market power. Section 3 presents the data and the empirical results and section 4 the results and discussion. Section 5 offers conclusions.

[3]Kumbhakar et al. (2012) points out that modelling approach can be applied to estimate the mark-up in output markets in any industry. Accordingly, the present study adopts their modelling to the estimation of market power in the U.S. meat industry, where the output is the products of beef and pork. In the seminal article the authors utilize a panel data: annual observations on sawmilling firms for the period 1974-1991. Likewise, the present study employ a panel data set as well: annual observations on the U.S. major exporting meat markets for the period 1980-2011. The stochastic frontier estimator of market power is produced following the methodology of the seminal paper.

2 The stochastic frontier estimator of market power

The present study considers an industry that exhibits market power when exporting its product to different markets/countries. Following Kumbhakar et al. (2012), the starting point of the model is the inequality $P > MC$, which indicates that the industry exerts oligopolistic power in the export market by setting price (P) above the marginal production cost (MC). Multiplying both sides of the inequality by $\frac{Y}{C}$, where Y is the exported output and C is the cost of producing Y, the inequality is converted into the following equality:

$$\frac{PY}{C} = \frac{\partial \ln C}{\partial \ln Y} + u, \quad u \geqslant 0 \tag{1}$$

where $\frac{PY}{C}$ is the export revenue share in the production cost of Y, $\frac{dlnC}{dlnY}$ is the scale elasticity and u is a nonnegative one–sided term that measures the markup in the export market. Kumbhakar et al. (2012) demonstrate that the term u is equivalent to the nonnegative one–sided random variable associated with technical inefficiency. In the present work, if the value of the nonnegative term u is significantly different than zero one can conclude that there is evidence of the presence of market power in the export market.

In order to empirically estimate the markup in the export market we need to define the cost function. We employ a standard translog cost function (Kumbhakar et al., 2012):

$$\begin{aligned} \ln C = {} & \beta_0 + \beta_Y \ln Y + \frac{1}{2}\beta_{YY}(\ln Y)^2 + \beta_{YT} T \ln Y + \beta_T T + \frac{1}{2}\beta_{TT} T^2 \\ & + \sum_{j=1}^{J} \beta_j \ln W_j + \sum_{j=1}^{J}\sum_{k=1}^{K} \beta_{jk} \ln W_j \ln W_k + \sum_{j=1}^{J} \beta_{jY} \ln W_j \ln Y \\ & + \sum_{j=1}^{J} \beta_{jT} T \ln W_j, \end{aligned} \tag{2}$$

where W's are the input prices. We impose symmetry and linear homogeneity

in (2). Imposing symmetry means that: $\beta_{jk} = \beta_{kj}$. In order to impose homogeneity, we normalize all input prices with respect to the price of the input k.

With symmetry and homogeneity imposed, we differentiate (2) with respect to the logarithm of the exported quantity ($\ln Y$):

$$\frac{\partial \ln C}{\partial \ln Y} = \beta_Y + \beta_{YY} \ln Y + \beta_{YT} T + \sum_{j=1}^{J-1} \beta_{jY} \ln \frac{W_j}{W_k} \tag{3}$$

Substituting (3) into (1) we get the stochastic version of the profit maximizing relationship for the exporting market:

$$\frac{P Y}{C} = \beta_Y + \beta_{YY} \ln Y + \beta_{YT} T + \sum_{j=1}^{J-1} \beta_{jY} \ln \frac{W_j}{W_k} + u + e \tag{4}$$

The composed error term $(u + e)$ in equation 4 is no different than the one from a stochastic cost frontier model. Equation 4 can be estimated using the maximum likelihood method which is commonly used to estimate a stochastic cost frontier. The maximum likelihood method is based on the distributional assumption of the errors. Following the literature (Kumbhakar et al., 2012; Kumbhakar and Lovell, 2003), the distributional assumptions regarding the terms u and e are: u is a normal variable truncated at zero from below, i.e. $u \sim N^+(0, \sigma_u^2)$, and e is the usual two-sided normal noise term, i.e. $e \sim N(0, \sigma_e^2)$.

We define the degree of market power exerted in the export market as the fraction by which the unit price of the exported quantity exceeds marginal cost:

$$\theta = \frac{P - MC}{MC} \tag{5}$$

Multiplying and dividing (5) by $\frac{Y}{C}$ we obtain:

$$\theta = \frac{u}{\partial \ln C / \partial \ln Y} \tag{6}$$

The Lerner index of oligopoly power in the export market is measured as:

$$L = \frac{\theta}{1+\theta} \tag{7}$$

In the case where the industry does not have significant market power in the export market, the estimated values of θ and L will be statistically no different than zero.

3 Data and empirical model

The empirical analysis employs a balanced panel data on the major U.S. beef and pork export markets for the time period 1980-2011.[4] Export data were collected from the Global Agricultural Trade System (GATS-FAS) of the United States Department of Agriculture – Foreign Agricultural Service (2017). Data on U.S. beef shipments to the markets of Japan (J), Mexico (M), Canada (C), South Korea (SK), Hong Kong/China (HK/C), Taiwan (TW), Central/South America (C/SA), ASEAN (AS), EU(28), Caribbean (CR), Middle East (ME) and Africa (AF) were used.[5] Beef exports include beef and beef variety meats. The aforementioned markets account for more than 95% of U.S. beef exports. For the case of the U.S. pork shipments – that include pork and pork variety meats – export data on the markets of Japan, Mexico, Canada, South Korea, Hong Kong/China, Taiwan, Central/South America, ASEAN, EU(28), Caribbean and Oceania (OC) were employed.[6] These markets ac-

[4]In the present study the number of major export markets are twelve for the case of the U.S. beef exports and eleven for the case of the U.S. pork exports.

[5]According to the GATS-FAS, for the beef exports, the leading export destinations for the market of Central/South America are the countries of Chile, Peru, Colombia, Guatemala, Honduras and El Salvador, for the ASEAN market the countries of Indonesia, Philippines and Vietnam, for the market of EU(28) the countries of Netherlands, Italy and Germany, for the Caribbean market the countries of Dominican Republic, Jamaica and the Bahamas, for the market of the Middle East the countries of Egypt, the United Arab Emirates and Kuwait and for the market of Africa the countries of South Africa, Cote D'Ivoire Angola and Gabon.

[6]According to the GATS-FAS, for the pork exports, the leading export destinations for the market of Central/South America are the countries of Colombia, Chile, Peru, Honduras, Guatemala and Panama, for the ASEAN market the countries of Philippines, Singapore and Vietnam, for the market of EU(28) the countries of United Kingdom, Germany and Netherlands, for the Caribbean

count for almost 99% of the U.S. pork exports. Data on the prices and quantities of the inputs employed at the processing stage of the U.S. meatpacking industry were obtained from the National Bureau of Economic Research–Manufacturing Industry Database (2017) for SIC2011 (NBER-SIC2011). The factors of production reported are capital, labor, material and energy.

The U.S. Meat Export Federation provides every single U.S. supplier for each major U.S. meat export destination (the same way used in the present study - webpage: https://www.usmef.org/export-resources/u-s-suppliers/, U.S. Meat Export Federation (2019)). For example, for the case of beef, when the destination market is ASEAN, there are 69 suppliers/exporters. Among them there are powerful meatpacking companies like Tyson, Cargill, JBS USA LLC, SYSCO International Food Group Inc., OSI Industries Inc. and the National Beef Packing Company. For the same destination market, but for the case of pork exports, there are 51 suppliers/exporters. Meatpacking companies like Tyson, Cargill, JBS USA LLC, Hormel Foods Corporation are present as pork exporters. The aforementioned companies belong in the top ten U.S. meat packing firms (sales in $, Panagiotou (2018)). In general, the majority of the exporters for the ASEAN destination market of U.S. beef and pork exports, are either meat manufacturers or they are vertically integrated firms participating in the processing stage of the meat supply chain. If we repeat the same procedure and identify each U.S. beef/pork exporter for every single destination market employed in this work, we will arrive at the same conclusion: most of them, somehow, are related with the meat processing sector. Accordingly, the fact that a large portion of the U.S. meat exporters are meat manufacturers, justifies the use of manufacturers' input data on the right-hand side of equation (4) in the present study.

market the countries of Dominican Republic, the Bahamas and Trinidad and Tobago and for the market of Oceania the countries of Australia and New Zealand.

Using equation 4, the relevant empirical relationship to be estimated is:

$$\begin{aligned}\frac{P_{it}\,Y_{it}}{C_t} &= \beta_Y + \beta_{YY}\ln Y_{it} + \beta_{YT}T + \beta_{YK}\ln\frac{w_{K_t}}{w_{E_t}} + \beta_{YL}\ln\frac{w_{L_t}}{w_{E_t}} \\ &\quad +\beta_{YE}\ln\frac{w_{M_t}}{w_{E_t}} + u_{it} + e_{it} \end{aligned} \tag{8}$$

Y_{it} is the volume of the exported quantity of beef or pork at time t to the i^{th} market. $P_{it}Y_{it}$ is the total value of export shipments to the i^{th} market at time t.[7] Both Y_{it} and $P_{it}Y_{it}$ are explicitly reported by the Global Agricultural Trade System of the United States Department of Agriculture – Foreign Agricultural Service (2017). W_{K_t} is the price of capital, W_{L_t} is the price of labor, W_{M_t} is the price of material and W_{E_t} is the price of energy at time t. NBER-SIC2011 database reports total labor expenditures and the total number of workers. We divide the former over the latter in order to calculate the price of labor in meatpacking plants. Capital is considered a quasi-fixed input. The annual user cost of capital (W_K) was calculated as the sum of the real interest rate and the depreciation rate. Following Lopez et al. (2018), a value of 0.05 was applied to the depreciation rate while assuming a linear form and a 20 year equipment working life in the food processing industry. Deflator indices were used for the prices of material and energy (NBER-SIC2011). The sum of expenditures on labor, capital, material and energy provide us with the total costs of production (C_t).[8] The parameter u_{it} is the markup in the i^{th} export market at time t.

The present study estimates (8) using time under time-varying effects (T) for every country and for each year. Accordingly, we obtain estimates of the markup parameter (u_{it}) for each observation year of every exporting market. Using the estimated values of u_{it}, the present study allows for the estimation of (export) market

[7]Variable Y_{it} is endogenous since it is a component of the dependent variable in equation 8. In order to solve the problem of endogeneity we adopt the methodology by Panagiotou and Azzam (2010), where beef exports are modeled as a two stage game. In the first stage the exported quantity is determined, whereas in the second stage of the game price is determined. In the empirical part of their study, Panagiotou and Azzam (2010) treat the exported quantity of beef as exogenous. This study adopts the same setting.

[8]The present study has estimated the costs of producing beef and pork, for the domestic and the export markets, respectively.

- and time - specific market power measurements and Lerner indices.

Furthermore, in order to account for transportation costs, we introduced a variable (Distance=D) that measures the mean distance between the U.S and the exporting regions, displayed at Figure 1.[9] Secondly, a dummy variable that accounts for the land border effect (Border=B) was introduced. The land border variable takes the value of one (1) for the proximate exporting markets of Canada and Mexico, and zero (0) for the rest of the exporting destinations.

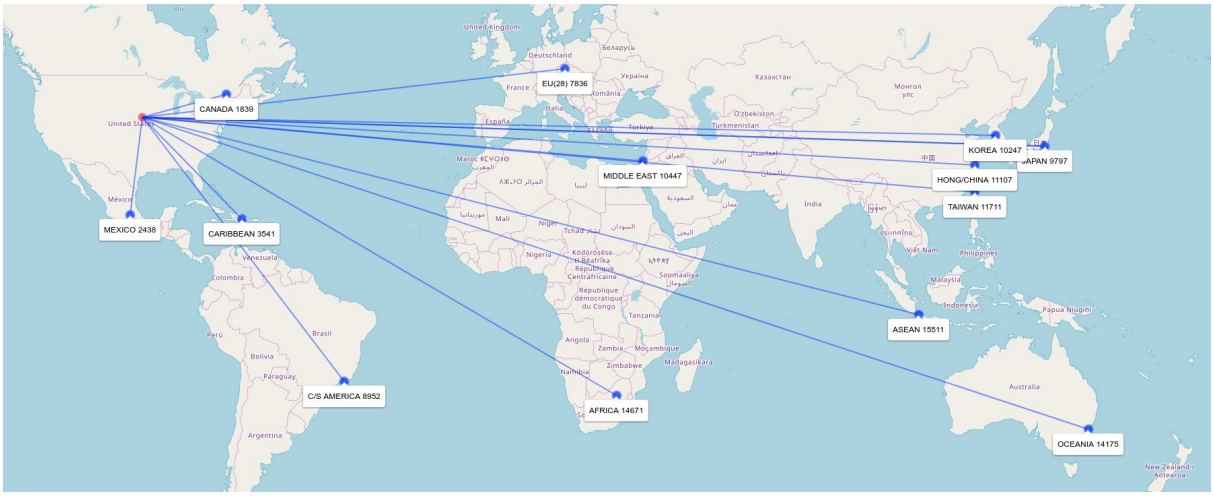

Figure 1: Distances (in Km) between center of USA (Omaha) and various places in the word to represent mean distances from USA to export regions. Calculations are based on the shortest path method using the WGS84 ellipsoid projection.

In the light of the preceding, the relationship to be estimated is:

$$\begin{aligned} \frac{P_{it}\,Y_{it}}{C_t} &= \beta_Y + \beta_{YY} \ln Y_{it} + \beta_{YT} T_{it} + \beta_{YK} \ln \frac{w_{K_t}}{w_{E_t}} + \beta_{YL} \ln \frac{w_{L_t}}{w_{E_t}} + \\ &\quad \beta_{YE} \ln \frac{w_{M_t}}{w_{E_t}} + \beta_D\, D_i + \beta_B\, B_i + u_{it} + e_{it} \end{aligned} \tag{9}$$

Before proceeding with the specifics of the estimation, there is an issue that needs to be clarified. In December of 2003, a case of mad cow disease was detected in Washington State of the United States of America. As a response many countries banned U.S. beef exports. As a consequence, between 2004-2006 there was a complete or partial ban on some of the US beef products. Even though there was a

[9] A table of the calculated distances can be also found in the online supplementary material.

ban, for the specific time period the Agricultural Trade System (GATS-FAS) of the USDA kept on reporting data since not all of the US beef products were banned.[10] The only exception is the country of South Korea, where for the year of 2005 (and only that) all U.S. exports of beef and beef variety meats were zero.

Employing the expression in (6) along with the estimated value of u_{it} from (9), we estimate the degree of market power ($\hat{\theta}_{it}$) for the i^{th} meat export market at time t as:

$$\hat{\theta}_{it} = \frac{\hat{u}_{it}}{\hat{\beta}_Y + \hat{\beta}_{YY} \ln Y_{it} + \hat{\beta}_{YT} T_{it} + \hat{\beta}_{YK} \ln \frac{w_{K_t}}{w_{E_t}} + \hat{\beta}_{YL} \ln \frac{w_{L_t}}{w_{E_t}} + \hat{\beta}_{YE} \ln \frac{w_{M_t}}{w_{E_t}} + \hat{\beta}_D D + \hat{\beta}_B B} \tag{10}$$

Accordingly, the Lerner index ($\hat{L}_{it}$) for the i^{th} meat export market at time t is obtained with the employment of equations (7) and (10):

$$\hat{L}_{it} = \frac{\hat{\theta}_{it}}{1 + \hat{\theta}_{it}} \tag{11}$$

In the case where the U.S. meat industry does not exert market power in the beef and/or pork export markets, the estimated values of $\hat{\theta}_{it}$ and $\hat{L}_{it}$ will be statistically no different than zero.

Our panel data consists of 383 observations – we exclude year 2005 for South Korea – for the case of the beef exports and 352 observations for the case of the pork exports. To ensure the stability of the panel data set we performed the standard Chow test (Baltagi, 2013). In both panel data sets we failed to reject the stability hypothesis (p-value > 0.99). All estimations, testing, and re-sampling in this study have been carried out using R (version 3.4.2, R Core (2017)) and packages provided (Coelli et al., 2013).

[10] Frozen, chilled, prepared and/or preserved beef are some of the products that were reported for the years 2004-2006.

4 Estimation results and discussion

Tables 1 through 6 present the findings of this study. Where necessary and in order to obtain robust empirical results, standard errors and confidence intervals have been calculated with a procedure similar to the jackknife methodology, with respect to the time dimension of the panel data set.

Table 1 reports the estimated parameters of the stochastic frontier model. The coefficients of the time varying effects which are positive and statistically significant in both cases indicating that the export revenue relative to the cost of production changes over time. In the beef exports, the border effect is positive and significant whereas the distance effect is negative and significant.

Table 1: Stochastic frontier estimation results

Parameter	Variable	Est. value	Std. error
Beef exports:			
$\hat{\beta}_Y$	Constant	6.863***	1.717
$\hat{\beta}_{YY}$	$\ln Y$	-0.041**	0.014
$\hat{\beta}_{YT}$	T	0.018***	0.003
$\hat{\beta}_{YK}$	$\ln \frac{w_K}{w_E}$	0.108**	0.031
$\hat{\beta}_{YL}$	$\ln \frac{w_L}{w_E}$	-0.050	0.123
$\hat{\beta}_{YM}$	$\ln \frac{w_M}{w_E}$	0.379***	0.106
$\hat{\beta}_{Distance}$	Distance	-0.621***	0.158
$\hat{\beta}_{Border}$	Border Effect	0.679*	0.384
u	Mean markup	0.573***	0.016
Pork exports:			
$\hat{\beta}_Y$	Constant	-0.610	1.445
$\hat{\beta}_{YY}$	$\ln Y$	-0.095***	0.012
$\hat{\beta}_{YT}$	T	0.009**	0.003
$\hat{\beta}_{YK}$	$\ln \frac{w_K}{w_E}$	-0.097***	0.026
$\hat{\beta}_{YL}$	$\ln \frac{w_L}{w_E}$	0.333***	0.123
$\hat{\beta}_{YM}$	$\ln \frac{w_M}{w_E}$	-0.109	0.084
$\hat{\beta}_{Distance}$	Distance	-0.179	0.139
$\hat{\beta}_{Border}$	Border Effect	-0.212	0.191
u	Mean markup	0.744***	0.011

('***', '**', '*'): 1%, 5% and 10% level of significance, respectively.

Table 2 presents the average estimates of the degree of market power and the Lerner index (LI) for the whole sample, for the U.S. beef and pork exports, respectively. On average, there is a higher degree of market power exerted in the U.S. beef export markets than in the U.S. pork export markets. The same results holds for the index of Lerner. According to the empirical findings, the estimate of the LI in the beef export markets is two and a half times higher than the estimate of the LI in the pork export markets.

Table 2: Average estimates of the degree of market power ($\hat{\theta}$) and the Lerner index ($\hat{L}\%$)

Parameter	Estimated value	Standard error
Beef Exports:		
Degree of market power ($\hat{\theta}$)	0.841***	0.031
Lerner Index ($\hat{L}\%$)	39.429***	1.045
Pork Exports:		
Degree of market power ($\hat{\theta}$)	0.213***	0.008
Lerner Index ($\hat{L}\%$)	16.840***	0.470

(***): One percent level of significance.

Lopez et al. (2018) found that for the poultry processors for the period 1990-2011, the average Lerner index (LI) was around 17%. This result is similar to the Lerner index for the pork exports (16.5%) estimated in this work. On the other hand, it is less than half than the estimate of the Lerner index for the U.S. beef exports (39.2%).

There are two main differences regarding the different empirical findings of the study by Lopez et al. (2018) and the findings of the present manuscript regarding the U.S. beef exports. First of all, Lopez et al. (2018) provide estimates of the Lerner Index for the U.S. poultry industry whereas the present study provides estimates the U.S. meat/beef packing industry. Furthermore, Lopez et al. (2018) estimate the market power exerted domestically (U.S. poultry), whereas the present article estimates the degree of market power exerted internationally (beef and pork worldwide). Secondly, there are some distinct structural differences between the two poultry and the beef sector that can justify the different outcomes. According to Norwood and Lusk (2018), the most important structural differences between the two industries are: i) short biological cycle vs long biological cycle (time period between breeding and slaughter is five months for poultry and two years for beef),

ii) multiple stages of production (poultry production has two basic stages: hatching and growing whereas beef contains three stages: cow-calf, stocker, and feeding), and iii) disperse geographic concentration (cattle move over a large geographic area during the three stages of production whereas in poultry all stages of production can be easily conducted in the same area).

Tables 3 and 4 report the annual estimates of the Lerner index ($\hat{L}\%$) for the aggregate U.S. beef and pork exports, respectively. For every observation year between 1980-2011, the estimated values of the Lerner index for the U.S. beef exports are strictly higher than the estimated values of the Lerner index for the U.S. pork exports. The gap between the two indexes widens as we move from 1980 and forward. Figure 2 presents graphically the empirical findings of tables 3 and 4. The LI for the U.S. beef export markets is, on average, stable for the period examined. Furthermore, red shaded area of the lower and upper values of the 95% confidence is quite wide. The wide red shaded area can be an indication that beef exporters can price different markets with quite different prices. This can potentially be another indicator of market power. for the case of U.S. pork export markets, the estimated value of the LI, as well as the width of the blue shaded area, decreases every year, staring from 1980. This can indicate that the international pork export market has become more competitive throughout the years, and there is very little room for different pricing to different markets.

Table 3: Annual estimates of the LI (%) for the U.S. beef exports

Year	**LI** ($\hat{L}\%$)	**Std. Error**	**Lower**	**Upper**
1980	38.961	6.846	25.543	52.378
1981	38.924	6.779	25.638	52.211
1982	39.849	6.854	26.415	53.284
1983	41.593	7.023	27.828	55.358
1984	40.246	6.794	26.930	53.562
1985	41.248	6.857	27.808	54.688
1986	39.678	6.510	26.919	52.438
1987	37.707	6.192	25.571	49.844
1988	37.267	6.181	25.152	49.383
1989	37.102	6.173	25.003	49.202
1990	36.301	5.982	24.577	48.026
1991	37.330	6.121	25.334	49.327
1992	38.674	6.240	26.444	50.904
1993	38.739	6.178	26.630	50.849
1994	38.439	6.133	26.418	50.460
1995	37.858	6.013	26.072	49.643
1996	38.591	6.074	26.687	50.495
1997	38.941	6.030	27.123	50.759
1998	38.577	5.843	27.126	50.029
1999	39.223	5.935	27.591	50.855
2000	39.508	5.953	27.840	51.176
2001	40.700	6.086	28.770	52.629
2002	41.875	6.236	29.653	54.097
2003	43.334	6.415	30.761	55.907
2004	39.983	5.692	28.827	51.138
2005	39.000	6.113	27.019	50.982
2006	38.536	5.402	27.948	49.126
2007	38.815	5.463	28.107	49.523
2008	41.222	5.799	29.856	52.589
2009	39.837	5.579	28.903	50.771
2010	39.401	5.470	28.680	50.121
2011	38.493	5.286	28.132	48.854

Note: According to the obtained values of the standard errors all parameter estimates are significant at the 1% level.

Table 4: Annual estimates of the LI (%) for the U.S. pork exports

Year	**LI** ($\hat{L}\%$)	**Std. Error**	**Lower**	**Upper**
1980	36.701	2.885	31.047	42.356
1981	33.908	2.602	28.808	39.009
1982	30.605	2.418	25.865	35.345
1983	27.915	2.206	23.592	32.238
1984	25.933	2.103	21.811	30.055
1985	23.827	1.997	19.913	27.741
1986	22.093	1.832	18.502	25.684
1987	20.758	1.709	17.409	24.107
1988	19.674	1.641	16.459	22.890
1989	18.861	1.529	15.865	21.857
1990	17.838	1.444	15.007	20.669
1991	16.883	1.349	14.240	19.526
1992	15.917	1.268	13.432	18.402
1993	15.184	1.199	12.835	17.534
1994	14.664	1.161	12.389	16.939
1995	14.151	1.114	11.968	16.335
1996	13.654	1.068	11.561	15.748
1997	13.119	1.015	11.129	15.109
1998	12.668	0.987	10.734	14.602
1999	12.179	0.940	10.337	14.020
2000	11.776	0.907	9.998	13.554
2001	11.374	0.868	9.672	13.076
2002	10.874	0.825	9.257	12.491
2003	10.577	0.800	9.009	12.144
2004	10.305	0.779	8.779	11.832
2005	10.154	0.755	8.674	11.634
2006	9.952	0.734	8.514	11.391
2007	9.659	0.706	8.276	11.042
2008	9.438	0.690	8.085	10.790
2009	9.141	0.664	7.839	10.443
2010	8.908	0.643	7.647	10.168
2011	8.674	0.618	7.462	9.886

Note: According to the obtained values of the standard errors all parameter estimates are significant at the 1% level.

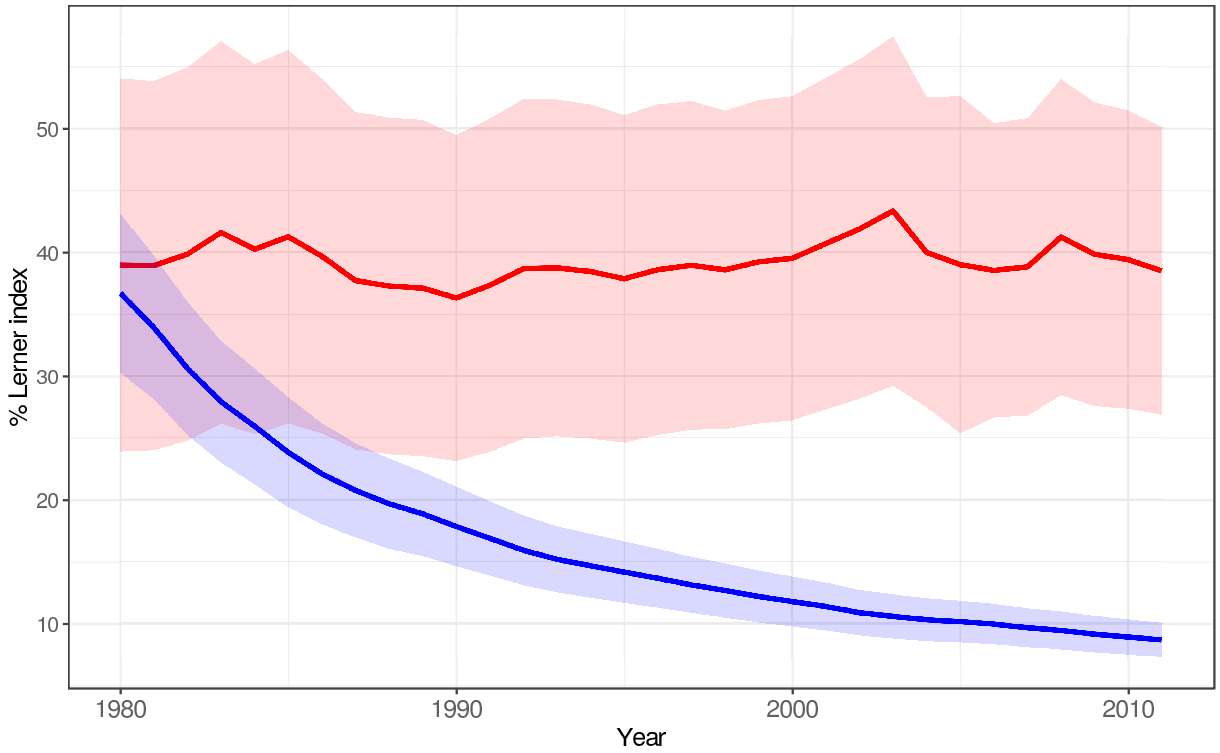

Figure 2: Annual estimates of the Lerner index for the U.S. beef (red line) and pork (blue line) exports. Shaded areas represent 95% confidence intervals of estimated values of the Lerner index among different markets according to Table 3 and Table 4.

Figure 3 presents graphically the empirical findings of time and country specific estimates of the Lerner index. In the majority of the markets that are present in both the U.S. beef and pork exports, the estimated Lerner index in the beef export market is higher, for each observation year, as compared to the estimated value of the Lerner index for the same pork export market. The only exception is the export market of Mexico where the LI for the U.S. pork is higher than the Lerner index for the U.S. beef exports for all the period examined here. Time specific estimates of the Lerner index (%) for each one of the beef and pork export markets and their corresponding standard errors are reported in the online supplementary material for the interested reader.

A possible interpretation for the aforementioned results is the fact that cattle are grain fed six months prior to slaughter while hogs aren't. This important detail makes the meat produced by the U.S. beef more tender as compared to the meat

produced by the rest of the beef exporting countries. Hence, worldwide, the grain-fed U.S. beef is considered to be of superior quality, and not a good substitute for lower quality grass-fed beef produced by the majority of the rest of the countries. This characteristic provides the U.S. beef exporters with a significant quality advantage in the world market. On the other hand, U.S. hogs do not have to be grain-fed for the last months prior to slaughter, which makes their meat quite comparable to the pork meat produced by the rest of the exporting countries. This "quality difference" between U.S.beef and U.S. pork is captured by the empirical findings of the present study: beef exporters, taking advantage of the superior quality of U.S. beef, can exert more market power as compared to the degree of market power exerted by the U.S. pork exporters. The latter produce meat of similar quality with the rest of the world.

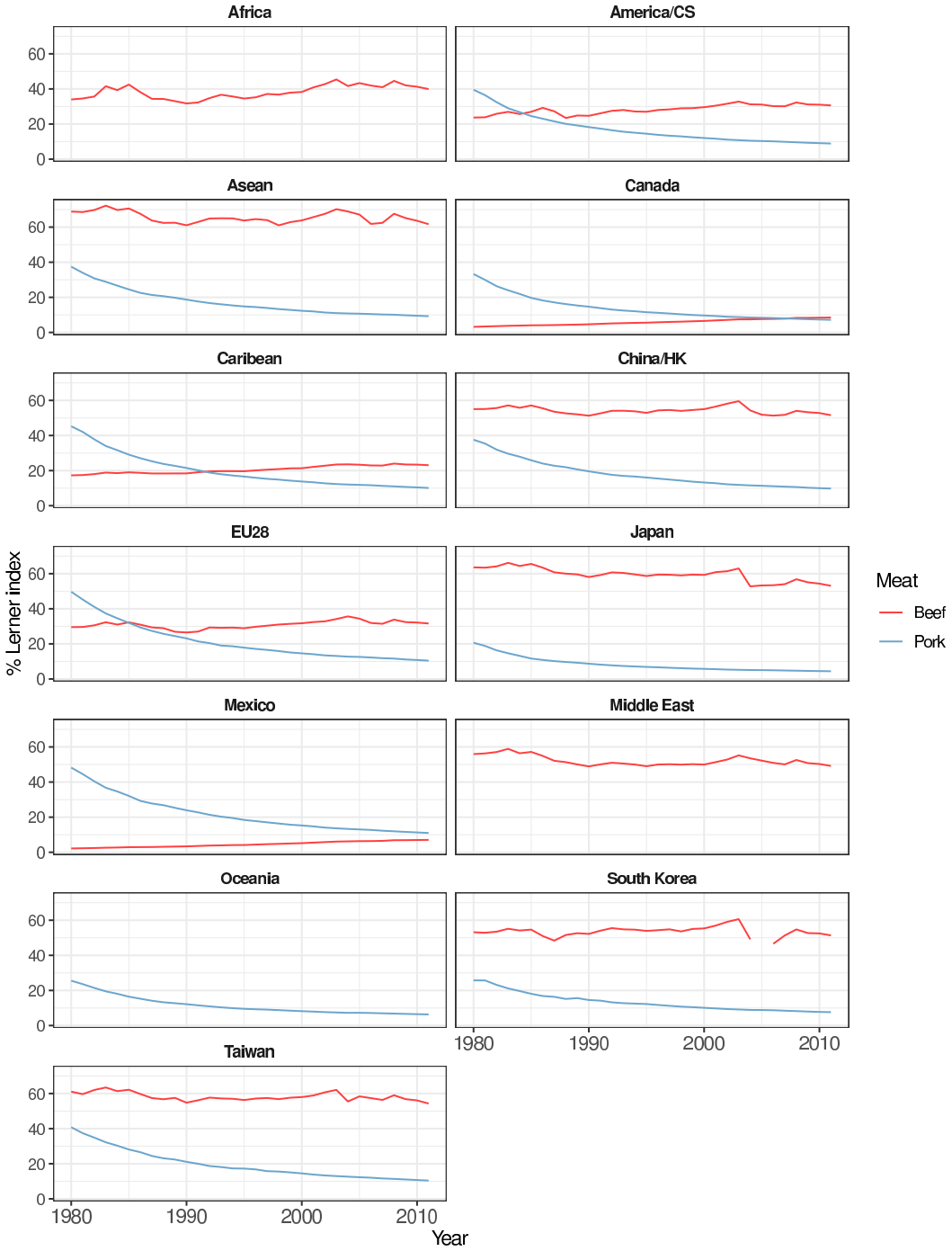

Figure 3: Time specific Lerner indices for each U.S. beef and pork export market

Table 5 and table 6 report the average estimates (for the whole sample) of the Lerner index (%) for each beef and pork export market, respectively. For the case of U.S. beef export markets, in the exporting regions of ASEAN, Hong Kong/China, Japan, South Korea and Taiwan, the Lerner index is above the average Lerner index

reported in 2. For the case of U.S. pork export markets, in the exporting destinations of ASEAN, C/S America, Caribbean, EU(28), Hong Kong/China, Mexico and Taiwan, the Lerner index is above the average Lerner index reported in Table 2.

Table 5: Average measures of the LI (%) for each beef exporting market

Beef Export Market	**Lerner index ($\hat{L}$%)***	**Std. Error**	**Lower**	**Upper**
AFRICA	38.221	0.677	36.894	39.548
ASEAN	65.518	0.553	64.433	66.602
C/S AMERICA	28.275	0.465	27.363	29.187
CANADA	5.819	0.297	5.236	6.401
CARIBBEAN	20.578	0.381	19.831	21.325
EU(28)	30.902	0.382	30.154	31.651
HONG KONG/CHINA	54.239	0.355	53.543	54.935
JAPAN	59.450	0.669	58.138	60.763
SOUTH KOREA	53.557	0.500	52.577	54.537
MEXICO	4.530	0.283	3.976	5.084
MIDDLE EAST	52.153	0.497	51.178	53.129
TAIWAN	58.196	0.408	57.396	58.996

(*): According to the obtained values of the standard errors all parameter estimates are significant at the one percent level.

Table 6: Average measures of the LI (%) for each pork exporting market

Pork Export Market	**Lerner index ($\hat{L}$%)***	**Std. Error**	**Lower**	**Upper**
ASEAN	17.115	1.351	14.467	19.764
C/S AMERICA	17.061	1.461	14.197	19.925
CANADA	13.789	1.215	11.408	16.170
CARIBBEAN	19.771	1.710	16.419	23.123
EU(28)	21.276	1.894	17.564	24.988
HONG KONG/CHINA	18.038	1.372	15.349	20.726
JAPAN	8.334	0.757	6.851	9.818
SOUTH KOREA	13.318	0.922	11.511	15.124
MEXICO	21.682	1.819	18.116	25.248
OCEANIA	11.445	0.932	9.618	13.273
TAIWAN	19.452	1.483	16.546	22.358

(*): According to the obtained values of the standard errors all parameter estimates are significant at the one percent level.

Overall, the U.S. meat exporters exert higher market power in the beef exporting markets than in the pork exporting regions. The only exceptions are the markets of Mexico and Canada where the LI for the case of U.S. pork exports is higher.

As we can observe in Table 5 and Table 6, the estimated value of the Lerner index is the highest in the export markets of ASEAN, Hong Kong/China, Japan, South Korea and Taiwan. Apart from the fact that Japan, Hong Kong/China, South Korea and Taiwan are the top export destination for the U.S. beef (volume and value), the above mentioned results comes as no surprise since consumers in those regions are very particular when it comes to their choice of meat. Nowhere in the world is the meat (namely beef) quality spectrum larger than in these countries. The fact that grain-fed U.S. beef is of superior quality and not a good substitute for lower quality grass-fed beef (majority of the rest of the countries) provides the U.S. beef exporters with a significant quality advantage in these particular markets over the rest of the beef exporting countries. Furthermore, the genetic improvements of U.S. livestock and the highly inspected U.S. meat products, have set U.S. beef apart from competition in the aforementioned exporting destinations. As a consequence, the U.S. meat exporters face a quite inelastic export demand curve for their shipments, enabling them to exert a higher degree of market power in these particular beef export markets as compared to the rest of the U.S. beef exporting destinations.

On the other hand, even though the markets of Mexico and Canada are in the top five export destinations for the U.S. beef products, the estimated value of the Lerner index is the lowest, relative to the estimates of the Lerner index in the rest of the export markets. One possible explanation, the proximity of the two countries/markets with the USA plays an important factor in the exertion of market power. U.S. beef exporters have to compete with beef producers located very close to them. Furthermore, the consumers of beef, especially in the case of Mexico, do not pay so much attention regarding the quality of their beef product, as opposed to the consumers of the markets of ASEAN, Hong Kong/China, Japan, South Korea

and Taiwan,. In the light of the preceding, the export demand curve that the U.S. meat exporters face in the market of Mexico is (relatively) more elastic, as compared to the rest of the export markets.

The results of tables 5 are 6 are presented together in the dynamic chart of Figure 4. The Lerner index in the U.S. beef export markets is higher than the Lerner index in the U.S. pork export markets except from the markets of Canada and Mexico. The U.S.pork exporters exert the highest degree of market power in the market of Mexico, Taiwan, Caribbean and the EU(28). The first two countries are among the top export destinations for the case of the U.S. pork.

On a final note, the results indicate that the 25% tariff on the U.S. beef and pork exports imposed by China, could have strategic implications mainly for the U.S. beef exports. As Table 5 reveals, the estimated value of the Lerner index for the U.S. beef exports to the markets of China and Hong Kong is quite high relevant to the rest of the markets. As a consequence and due to the imposition of the tariff, U.S. beef exporters might have to mitigate the degree of market power that they exert in order to compete with the rest of the exporters in the market of China/Hong Kong.

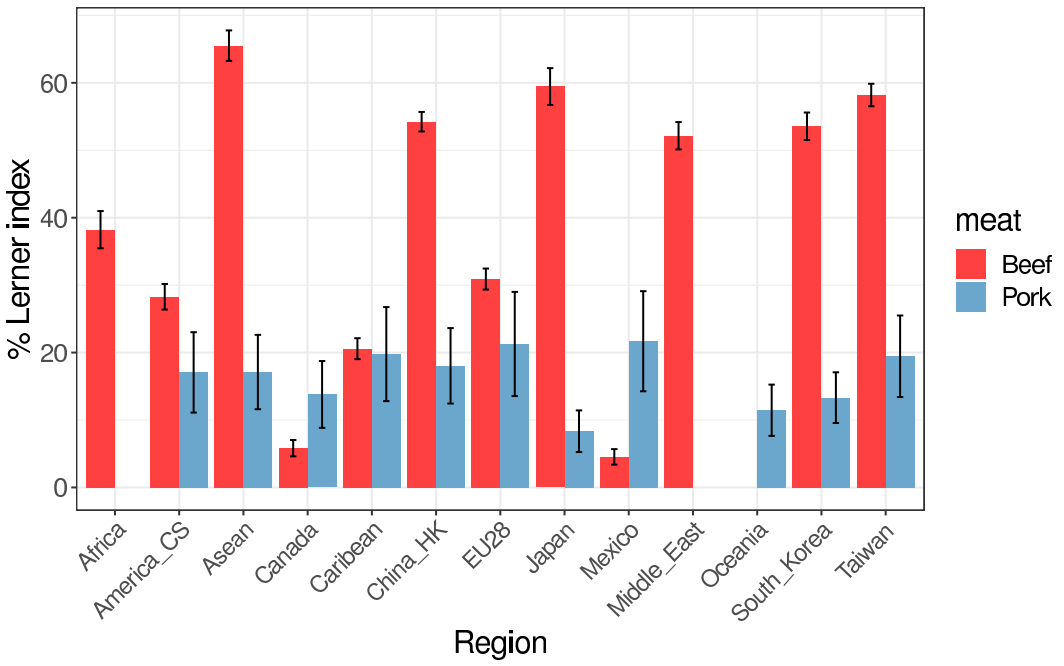

Figure 4: Average Lerner indices for both the US beef and pork export markets.

5 Conclusions

In the present article, we employ the stochastic frontier (SF) approach of market power estimation (Kumbhakar et al., 2012), in order to measure the degree of market power in each one of the major U.S. beef and pork export markets. In contrast to traditional SF analysis, the present work allows for the estimation of market - and time - specific Lerner indices.

In the international arena, competition is much more intense than domestically, since there are more players to compete against. In 2018, there were 15 beef exporting countries with market share ranging from 2.2% (Paraguay) to 14.7% (USA) - http://www.worldstopexports.com/beef-exports-by-country/. For the same year, there were 11 pork exporting countries with market share ranging from 2% (Mexico) to 16.2% (USA) – http://www.worldstopexports.com/pork-exports-by-country/.

Results were obtained with the use of balanced panel data on the major beef and pork export markets as well as data from the U.S. meatpacking sector, for the time period 1980-2011. Based on our findings, the average Lerner index was 39.249% and 16.480% in the U.S. beef and pork exports, respectively, indicating that the U.S. meat industry exerts market power when exporting its product. Market power estimates in the case of the U.S. beef exports were strictly higher than market power estimates for the U.S. pork exports, for every single observation year.

The U.S. meat industry exerts the highest degree of market power in the markets of ASEAN, Hong Kong/China, Japan, South Korea and Taiwan. The estimated value of the Lerner index in these particular beef export markets ranges from is 53.6% (South Korea) to 65.5% (ASEAN). The fact that U.S. beef is considered of superior quality (grain-fed, genetic improvements) along with the preferences of the consumers of the aforementioned markets, who are very particular when it comes to their choice of beef, provides the U.S. beef exporters with a significant advantage over the rest of the beef exporting countries. Accordingly, one can conclude that the U.S. beef exporters face a quite inelastic demand curve in these exporting destinations.

From a methodological point of view, allowing for the estimation of market - and time - specific Lerner indices makes possible comparison, not only through time, but also between the major export markets for the U.S. meatpacking industry. Hence, we can identify the export markets in which the U.S. meat exporters exert the highest/lowest degree of market power.

One of the limitations of the present work is that due to the nature of the data utilized we cannot explicitly account for cost shifters (the exchange rate of the exporter vs. the destination market), demand shifters (real income and the price level for each destination market) as well as transportation costs (as measured by a variable measuring the distance between the USA and the exporting destinations). According to the USDA-ERS/Livestock and Meat International Data, USA exports beef to 204 countries and pork to 194 countries (these are numbers throughout the years). The inclusion of every single country would complicate the results, make it difficult to draw useful conclusions and is beyond the scope of the present work.

A potential avenue for future research would be to measure the degree of market power exerted by the rest of the world's major players meat trade. The results obtained from this study, will provide us with a more complete picture about the degree of competitiveness of the global meat market.

References

Arnade, C., Pick, D., and Gopinath, M. (1998). Testing oligopoly power in domestic and export markets. *Applied Economics*, 30(6):753–760.

Baltagi, B. H. (2013). *Econometric Analysis of Panel Data*. Wiley, 5th edition.

Coelli, T., Henningsen, A., and Henningsen (2013). frontier: Stochastic Frontier Analysis. Available at: http://CRAN.R-Project.org/package=frontier.

Felt, M.-H., Gervais, J.-P., and Larue, B. (2011). Market power and import bans: the case of Japanese pork imports. *Agribusiness*, 27(1):47–61.

Henneberry, S. R. and Mutondo, J. E. (2009). Agricultural trade among NAFTA countries: a case study of US meat exports. *Review of agricultural economics*, 31(3):424–445.

Kumbhakar, S. C., Baardsen, S., and Lien, G. (2012). A new method for estimating market power with an application to Norwegian sawmilling. *Review of Industrial Organization*, 40(2):109–129.

Kumbhakar, S. C. and Lovell, C. K. (2003). *Stochastic frontier analysis*. Cambridge University Press.

Lopez, R. A., He, X., and Azzam, A. (2018). Stochastic Frontier Estimation of Market Power in the Food Industries. *Journal of agricultural economics*, 69(1):3–17.

Miljkovic, D., Brester, G. W., and Marsh, J. M. (2003). Exchange rate pass-through, price discrimination, and US meat export prices. *Applied Economics*, 35(6):641–650.

Miljkovic, D., Marsh, J. M., and Brester, G. W. (2002). Japanese import demand for US beef and pork: Effects on US red meat exports and livestock prices. *Journal of Agricultural and Applied Economics*, 34(3):501–512.

National Bureau of Economic Research–Manufacturing Industry Database (2017). NBER-CES Manufacturing Industry Database. Available at: http://www.nber.org/nberces/. –Accessed, September 2017.

Norwood, F. B. and Lusk, J. L. (2018). *Agricultural marketing and price analysis*. Waveland Press.

Panagiotou, D. (2008). Trade bans, imperfect competition and welfare: BSE and the US beef industry. *ETD collection for University of Nebraska - Lincoln. AAI3315057. Available at: http://digitalcommons.unl.edu/dissertations/AAI3315057*.

Panagiotou, D. (2018). Collusion-enhancing effects of the own-and cross-price demand elasticities in merging multiproduct food industries: The case of chicken and red meat in the United States. *Outlook on Agriculture*, 47(3):223–232.

Panagiotou, D. (2019). Market Power Effects of the Livestock Mandatory Reporting Act in the US Meat Industry: a Stochastic Frontier Approach Under Uncertainty. *Journal of Industry, Competition and Trade*, 19(1):103–122.

Panagiotou, D. and Azzam, A. M. (2010). Trade bans, imperfect competition, and welfare: Bse and the US beef industry. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 58(1):109–129.

Panagiotou, D. and Stavrakoudis, A. (2017). A stochastic production frontier estimator of the degree of oligopsony power in the US cattle industry. *Journal of Industry, Competition and Trade*, 17(1):121–133.

Panagiotou, D. and Stavrakoudis, A. (2018). A stochastic frontier estimator of the aggregate degree of market power exerted by the US meat packing industry. *Journal of Industrial and Business Economics*, 45(3):387–401.

Plain, Ron (2014). Economic Impact of U.S. Pork Trade, 1986-2014. Available at: https://agebb.missouri.edu/mkt/exportUSpaper.htm. Working paper, University of Missouri-Columbia Accessed November, Accessed November 2017.

R Core, T. (2017). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2014.

Reed, M. and Iswariyardi, A. (2001). Competitive forces in the Japanese beef market. In *Annual Meeting of the International Agricultural Trade Research Consortium (IATRC), Auckland, New Zealand*.

Reed, M. R. and Saghaian, S. H. (2004). Measuring the intensity of competition in the Japanese beef market. *Journal of Agricultural and Applied Economics*, 36(1):113–121.

Scalco, P. R., Lopez, R. A., and He, X. (2017). Buyer and/or seller power? An application to the Brazilian milk market. *Applied Economics Letters*, 24(16):1173–1176.

United States Department of Agriculture – Economic Research Service (2017). Livestock and meat international trade data. Available at: https://www.ers.usda.gov/data-products/livestock-and-meat-international-trade-data/. Accessed September, 2017.

United States Department of Agriculture – Foreign Agricultural Service (2017). Global agricultural trade system. Available at: https://apps.fas.usda.gov/gats/default.aspx. accessed October, 2017.

U.S. Meat Export Federation (2017). Statistics and trade access-export statistics. Available at: https://www.usmef.org/usmef-statistics-and-trade-access/export-statistics/. Accessed September, 2017.

U.S. Meat Export Federation (2019). Statistics and trade access-export statistics. Available at: https://www.usmef.org/export-resources/u-s-suppliers/. Accessed July, 2019.

Appendix

Online supplementary material to accompany the article:

A stochastic frontier analysis approach for estimating market power in the major U.S. meat export markets

Distances between USA and export markets

Table A1: Distance from USA

Region	Distance (Km)
AFRICA	14671
ASEAN	15511
C/S AMERICA	8952
CANADA	1839
CARIBBEAN	3541
EU(28)	7836
HONG/CHINA	11107
JAPAN	9797
SOUTH KOREA	10247
MEXICO	2438
MIDDLE EAST	10447
OCEANIA	14175
TAIWAN	11711

Figures and Charts

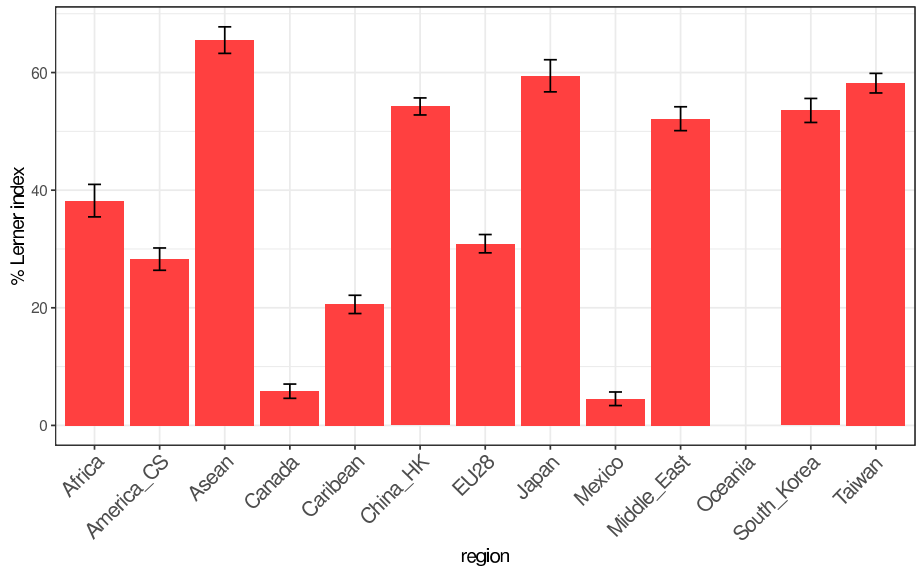

Figure A1: Average Lerner index for each one of the US beef export markets

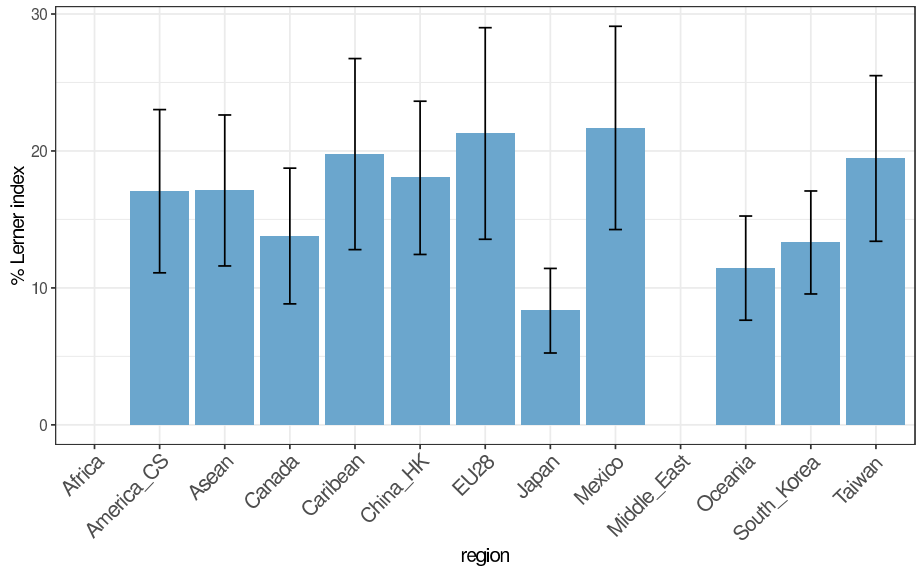

Figure A2: Average Lerner index for each one of the US pork export markets

Time and market specific estimates of the Lerner index

Table A2: Time and region specific estimates of the Lerner index (%) for beef exports (standard errors for each estimated value are reported in Table A4)

Year	AF	AS	CS/A	C	CR	EU	HK/C	J	SK	M	ME	TW
1980	33.988	68.854	23.692	3.182	17.295	29.533	55.041	63.599	53.165	2.185	55.924	61.066
1981	34.562	68.587	23.849	3.393	17.465	29.628	55.085	63.417	52.876	2.276	56.320	59.636
1982	35.662	69.733	25.840	3.566	18.015	30.565	55.645	64.152	53.469	2.422	57.109	62.016
1983	41.548	72.213	26.964	3.780	18.880	32.328	57.154	66.167	55.147	2.599	58.907	63.430
1984	39.309	69.740	25.695	3.885	18.568	30.998	55.787	64.382	54.141	2.706	56.394	61.350
1985	42.489	70.608	26.983	4.061	19.035	32.277	57.105	65.556	54.654	2.898	57.170	62.142
1986	38.144	67.563	29.225	4.102	18.718	30.943	55.493	63.423	50.991	2.946	54.888	59.702
1987	34.345	63.738	27.260	4.192	18.376	29.383	53.539	60.772	48.379	2.991	52.114	57.401
1988	34.291	62.397	23.445	4.326	18.362	28.952	52.614	60.011	51.596	3.134	51.341	56.737
1989	33.032	62.495	24.867	4.461	18.393	26.902	52.052	59.598	52.616	3.255	50.046	57.509
1990	31.736	61.044	24.695	4.642	18.404	26.501	51.280	58.072	52.207	3.354	48.912	54.770
1991	32.279	62.946	26.096	4.894	19.082	27.010	52.606	59.214	54.040	3.596	50.057	56.144
1992	34.790	64.912	27.535	5.136	19.566	29.352	54.071	60.738	55.508	3.812	51.006	57.660
1993	36.704	65.033	28.001	5.296	19.695	29.147	54.106	60.420	54.805	3.937	50.550	57.180
1994	35.694	64.978	27.144	5.443	19.685	29.276	53.767	59.575	54.629	4.091	49.965	57.015
1995	34.533	63.745	26.995	5.555	19.636	28.911	52.902	58.646	53.931	4.139	49.019	56.281
1996	35.235	64.568	27.997	5.783	20.120	29.755	54.303	59.485	54.333	4.385	49.996	57.133
1997	37.128	63.959	28.353	5.984	20.550	30.362	54.528	59.394	54.820	4.614	50.151	57.446
1998	36.755	61.014	28.974	6.137	20.876	31.018	54.019	59.014	53.614	4.789	49.931	56.785
1999	37.884	62.836	29.055	6.354	21.283	31.425	54.527	59.462	55.036	5.008	50.195	57.616
2000	38.277	63.820	29.610	6.536	21.353	31.741	55.005	59.288	55.335	5.189	49.966	57.974
2001	40.863	65.690	30.457	6.847	22.122	32.429	56.469	60.854	56.941	5.506	51.354	58.863
2002	42.737	67.535	31.570	7.143	22.793	32.837	58.115	61.394	59.078	5.799	52.837	60.663
2003	45.406	70.217	32.785	7.442	23.482	34.163	59.560	62.977	60.624	6.090	55.196	62.067
2004	41.646	68.893	31.223	7.452	23.566	35.671	54.275	52.768	49.114	6.209	53.525	55.452
2005	43.343	67.132	31.090	7.616	23.357	34.388	51.856	53.292	-	6.334	52.214	58.379
2006	41.922	61.812	30.173	7.699	22.944	31.909	51.324	53.410	46.587	6.377	50.917	57.365
2007	40.975	62.452	30.122	7.851	22.883	31.461	51.763	54.016	51.337	6.494	50.082	56.339
2008	44.581	67.605	32.290	8.285	24.004	33.819	54.049	56.823	54.759	6.874	52.579	59.002
2009	42.038	65.156	31.161	8.292	23.493	32.407	53.258	55.078	52.677	6.901	50.783	56.799
2010	41.249	63.611	31.035	8.395	23.404	32.169	52.796	54.325	52.496	6.986	50.278	56.062
2011	39.928	61.677	30.616	8.473	23.086	31.614	51.556	53.087	51.354	7.055	49.181	54.287

Note: Standard errors were obtained with a procedure similar to the jackknife method. Table A4 reports the mean value of the Lerner index and the standard errors According to the obtained values of the standard errors all parameter estimates are statistically significant.

Table A3: Time and region specific estimates of the Lerner index (%) for pork exports (standard errors for each estimated value are reported in Table A5)

Year	A	CS/A	C	CR	EU	HK/C	J	SK	M	OC	TW
1980	37.451	39.540	33.238	45.248	49.710	37.587	20.650	25.732	48.229	25.551	40.778
1981	33.941	36.424	29.943	42.028	45.245	35.383	18.823	25.702	44.528	23.590	37.382
1982	30.806	32.451	26.348	37.804	41.092	31.950	16.314	23.168	40.416	21.429	34.876
1983	28.825	28.982	23.999	34.015	37.348	29.615	14.663	21.169	36.748	19.485	32.215
1984	26.637	26.786	21.929	31.602	34.572	27.920	13.170	19.657	34.630	18.082	30.279
1985	24.512	24.549	19.682	29.081	31.974	25.881	11.652	18.099	32.105	16.451	28.108
1986	22.532	23.042	18.219	27.060	29.349	24.031	10.847	16.835	29.271	15.275	26.559
1987	21.343	21.519	17.098	25.306	27.399	22.772	10.183	16.365	27.785	14.128	24.441
1988	20.646	20.109	16.153	23.801	25.734	21.942	9.697	15.157	26.816	13.269	23.095
1989	19.755	19.200	15.342	22.696	24.460	20.683	9.261	15.635	25.314	12.726	22.400
1990	18.694	18.252	14.665	21.482	23.142	19.582	8.702	14.545	23.927	12.162	21.064
1991	17.648	17.411	13.848	20.190	21.415	18.580	8.185	14.193	22.729	11.513	19.998
1992	16.724	16.463	13.018	18.858	20.442	17.590	7.779	13.224	21.359	10.944	18.686
1993	16.024	15.619	12.469	17.935	19.049	16.996	7.415	12.745	20.281	10.373	18.120
1994	15.381	15.039	12.055	17.217	18.640	16.601	7.122	12.505	19.501	9.911	17.334
1995	14.808	14.490	11.509	16.616	17.857	16.054	6.877	12.271	18.421	9.526	17.235
1996	14.462	13.839	11.172	15.926	17.132	15.465	6.671	11.716	17.760	9.287	16.768
1997	13.909	13.345	10.772	15.298	16.564	14.891	6.395	11.244	17.043	9.081	15.770
1998	13.299	12.985	10.333	14.862	15.912	14.322	6.162	10.781	16.377	8.774	15.541
1999	12.829	12.475	9.934	14.277	15.103	13.696	5.937	10.473	15.704	8.478	15.062
2000	12.325	12.044	9.651	13.786	14.604	13.239	5.772	10.116	15.285	8.198	14.515
2001	11.971	11.644	9.349	13.343	14.114	12.811	5.599	9.757	14.731	7.958	13.837
2002	11.339	11.122	8.948	12.753	13.453	12.197	5.365	9.395	14.063	7.665	13.315
2003	11.003	10.821	8.730	12.344	13.122	11.875	5.235	9.164	13.644	7.447	12.961
2004	10.806	10.505	8.494	12.063	12.726	11.567	5.110	8.898	13.301	7.260	12.632
2005	10.672	10.332	8.362	11.882	12.581	11.363	5.048	8.848	13.014	7.277	12.310
2006	10.477	10.148	8.203	11.670	12.254	11.109	4.963	8.717	12.729	7.161	12.044
2007	10.225	9.871	7.972	11.296	11.857	10.855	4.838	8.453	12.288	6.978	11.614
2008	10.081	9.608	7.760	11.016	11.619	10.637	4.731	8.242	11.944	6.816	11.358
2009	9.774	9.328	7.530	10.694	11.124	10.245	4.602	7.973	11.609	6.631	11.041
2010	9.533	9.118	7.353	10.419	10.805	9.993	4.507	7.760	11.301	6.482	10.712
2011	9.257	8.894	7.175	10.111	10.441	9.772	4.414	7.626	10.980	6.337	10.405

Note: Standard errors were obtained with a procedure similar to the jackknife method. Table A5 reports the mean value of the Lerner index and the standard errors. According to the obtained values of the standard errors all parameter estimates are statistically significant.

Standard Errors of time and region specific estimates of the Lerner index

Standard errors and confidence intervals of the Lerner index have been calculated with a procedure similar to the jackknife methodology, with respect to the time dimension of the panel data set.

The Lerner index has been estimated 32 times by excluding one year at a time from the panel data set, from 1980 to 2011. Thus, for each year and for every region, 31 values of the Lerner index have been calculated. The tables below present the mean value, the standard error and the confidence interval (95%) of these vectors.

Table A4: Mean values for the Lerner index and standard errors of time and region specific estimates for the US beef exports (corresponding to Table A2)

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
AFRICA	1980	33.680	0.131	33.425	33.936
	1981	28.461	0.191	28.086	28.836
	1982	29.467	0.180	29.115	29.819
	1983	34.004	0.465	33.092	34.916
	1984	27.793	0.322	27.162	28.424
	1985	28.027	0.284	27.470	28.583
	1986	21.819	0.449	20.939	22.700
	1987	22.293	0.177	21.946	22.640
	1988	12.848	1.038	10.814	14.882
	1989	9.334	0.092	9.154	9.515
	1990	9.373	0.063	9.249	9.497
	1991	13.757	0.541	12.698	14.817
	1992	15.645	0.052	15.544	15.746
	1993	23.451	1.195	21.109	25.794

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1994	26.095	0.434	25.244	26.947
	1995	23.599	0.218	23.172	24.027
	1996	26.687	0.799	25.120	28.253
	1997	30.167	0.189	29.797	30.538
	1998	28.626	0.242	28.152	29.100
	1999	29.215	0.582	28.074	30.356
	2000	33.499	0.520	32.479	34.519
	2001	28.911	0.477	27.976	29.845
	2002	33.057	0.082	32.897	33.217
	2003	32.096	0.156	31.791	32.402
	2004	26.212	1.305	23.654	28.770
	2005	13.569	0.107	13.360	13.779
	2006	18.311	1.639	15.100	21.523
	2007	37.968	0.472	37.043	38.893
	2008	30.901	0.131	30.644	31.158
	2009	30.951	0.254	30.453	31.448
	2010	35.662	0.158	35.352	35.973
	2011	35.990	0.079	35.836	36.145
ASEAN	1980	70.699	0.090	70.522	70.876
	1981	65.139	0.287	64.576	65.702
	1982	64.324	0.289	63.757	64.890
	1983	66.118	0.392	65.349	66.887
	1984	61.003	0.230	60.553	61.454
	1985	60.432	0.228	59.986	60.879
	1986	53.632	0.456	52.737	54.527
	1987	52.569	0.278	52.024	53.115

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1988	34.263	1.834	30.668	37.858
	1989	27.935	0.253	27.439	28.431
	1990	27.302	0.196	26.918	27.687
	1991	35.541	1.075	33.435	37.648
	1992	39.518	0.168	39.190	39.847
	1993	50.758	1.714	47.399	54.117
	1994	54.157	0.658	52.868	55.445
	1995	48.817	0.172	48.480	49.154
	1996	52.093	0.901	50.326	53.860
	1997	56.745	0.132	56.485	57.005
	1998	59.809	0.678	58.481	61.137
	1999	62.614	0.229	62.164	63.063
	2000	56.973	0.670	55.660	58.286
	2001	54.222	0.569	53.107	55.337
	2002	57.943	0.287	57.380	58.506
	2003	55.874	0.163	55.554	56.193
	2004	47.993	1.913	44.243	51.742
	2005	29.651	0.212	29.234	30.067
	2006	36.285	2.241	31.892	40.678
	2007	61.903	0.657	60.615	63.191
	2008	53.033	0.113	52.812	53.255
	2009	54.671	0.196	54.288	55.055
	2010	57.227	0.135	56.963	57.492
	2011	58.260	0.063	58.137	58.383
C/S AMERICA	1980	38.037	0.209	37.627	38.447
	1981	30.709	0.358	30.007	31.410

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1982	30.523	0.267	30.000	31.046
	1983	31.001	0.226	30.557	31.445
	1984	30.854	0.156	30.548	31.159
	1985	26.915	0.329	26.270	27.559
	1986	25.037	0.129	24.783	25.291
	1987	23.807	0.167	23.479	24.134
	1988	13.891	1.000	11.931	15.851
	1989	10.530	0.098	10.338	10.722
	1990	10.391	0.091	10.213	10.569
	1991	14.915	0.581	13.777	16.053
	1992	17.893	0.131	17.637	18.149
	1993	27.101	1.377	24.402	29.800
	1994	28.626	0.667	27.319	29.934
	1995	25.583	0.117	25.354	25.812
	1996	28.393	0.506	27.401	29.386
	1997	31.951	0.213	31.534	32.368
	1998	36.117	0.538	35.062	37.171
	1999	38.261	0.227	37.815	38.706
	2000	33.409	0.480	32.469	34.350
	2001	30.409	0.279	29.862	30.955
	2002	32.594	0.274	32.056	33.132
	2003	33.929	0.262	33.415	34.443
	2004	27.335	1.277	24.832	29.839
	2005	15.170	0.153	14.871	15.469
	2006	19.679	1.662	16.423	22.936
	2007	39.424	0.446	38.550	40.298

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2008	33.510	0.182	33.152	33.867
	2009	33.361	0.259	32.853	33.868
	2010	37.294	0.252	36.799	37.789
	2011	40.278	0.200	39.887	40.670
CANADA	1980	20.518	0.328	19.876	21.160
	1981	13.011	0.270	12.482	13.539
	1982	14.654	0.248	14.168	15.139
	1983	13.673	0.292	13.101	14.246
	1984	15.028	0.259	14.520	15.536
	1985	12.389	0.478	11.452	13.327
	1986	11.399	0.285	10.841	11.958
	1987	10.516	0.228	10.069	10.964
	1988	6.134	0.586	4.985	7.283
	1989	4.581	0.124	4.338	4.824
	1990	4.596	0.131	4.338	4.853
	1991	6.939	0.276	6.399	7.480
	1992	8.639	0.163	8.321	8.958
	1993	13.268	0.644	12.005	14.531
	1994	15.044	0.515	14.034	16.054
	1995	13.249	0.270	12.719	13.779
	1996	14.673	0.337	14.012	15.333
	1997	17.928	0.280	17.379	18.478
	1998	21.757	0.324	21.123	22.392
	1999	22.996	0.524	21.970	24.023
	2000	19.209	0.446	18.335	20.083
	2001	17.306	0.331	16.657	17.955

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2002	19.230	0.351	18.543	19.918
	2003	18.002	1.189	15.672	20.332
	2004	8.596	0.182	8.239	8.953
	2005	8.457	0.203	8.060	8.854
	2006	11.509	1.119	9.316	13.703
	2007	25.580	0.560	24.482	26.678
	2008	20.991	0.326	20.351	21.631
	2009	20.807	0.307	20.206	21.409
	2010	23.622	0.411	22.818	24.427
	2011	28.441	0.431	27.596	29.286
CARIBBEAN	1980	43.822	0.188	43.452	44.191
	1981	33.475	0.261	32.965	33.986
	1982	33.638	0.335	32.981	34.294
	1983	32.719	0.226	32.276	33.162
	1984	36.448	0.410	35.645	37.252
	1985	31.193	0.499	30.216	32.170
	1986	26.600	0.329	25.956	27.245
	1987	24.590	0.163	24.270	24.909
	1988	14.590	0.986	12.658	16.523
	1989	11.581	0.099	11.387	11.775
	1990	18.218	0.817	16.616	19.821
	1991	19.959	0.152	19.661	20.257
	1992	19.483	0.187	19.117	19.849
	1993	28.439	1.462	25.573	31.305
	1994	30.634	0.472	29.708	31.560
	1995	27.151	0.199	26.761	27.541

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1996	28.933	0.631	27.697	30.170
	1997	35.307	0.559	34.212	36.403
	1998	41.278	0.624	40.055	42.502
	1999	41.385	0.577	40.255	42.515
	2000	35.921	0.242	35.447	36.396
	2001	34.596	0.166	34.271	34.921
	2002	36.016	0.318	35.393	36.638
	2003	32.386	1.823	28.812	35.960
	2004	16.459	0.123	16.217	16.701
	2005	16.190	0.158	15.880	16.499
	2006	20.258	1.683	16.959	23.557
	2007	39.186	0.377	38.446	39.926
	2008	35.000	0.142	34.721	35.278
	2009	33.639	0.293	33.065	34.213
	2010	39.309	0.280	38.759	39.859
	2011	39.265	0.568	38.152	40.378
EU(28)	1980	46.908	0.448	46.029	47.786
	1981	35.134	0.289	34.568	35.700
	1982	33.884	0.236	33.421	34.346
	1983	33.477	0.144	33.194	33.760
	1984	40.463	0.477	39.529	41.397
	1985	33.449	0.616	32.241	34.657
	1986	27.501	0.296	26.920	28.082
	1987	26.783	0.111	26.565	27.001
	1988	15.668	1.171	13.373	17.963
	1989	12.217	0.080	12.060	12.374

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1990	18.964	0.789	17.418	20.510
	1991	20.681	0.137	20.412	20.949
	1992	19.894	0.123	19.653	20.135
	1993	28.168	1.368	25.486	30.849
	1994	30.984	0.283	30.429	31.540
	1995	27.855	0.229	27.407	28.304
	1996	30.130	0.804	28.554	31.705
	1997	36.575	0.483	35.629	37.522
	1998	38.916	0.883	37.186	40.646
	1999	42.060	0.421	41.234	42.886
	2000	37.021	0.240	36.550	37.491
	2001	34.944	0.281	34.393	35.494
	2002	37.643	0.407	36.845	38.442
	2003	34.825	2.015	30.875	38.775
	2004	17.145	0.149	16.852	17.438
	2005	16.466	0.125	16.221	16.712
	2006	20.251	1.494	17.323	23.179
	2007	38.249	0.196	37.865	38.633
	2008	36.624	0.488	35.668	37.580
	2009	44.456	0.271	43.925	44.987
	2010	40.643	0.154	40.340	40.945
	2011	40.707	0.194	40.327	41.087
HONG/CHINA	1980	66.604	0.387	65.847	67.362
	1981	59.527	0.126	59.280	59.774
	1982	56.378	0.271	55.846	56.910
	1983	58.754	0.330	58.108	59.401

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1984	64.025	0.429	63.185	64.865
	1985	53.922	0.712	52.527	55.318
	1986	49.075	0.321	48.446	49.704
	1987	46.540	0.230	46.090	46.990
	1988	29.832	1.670	26.558	33.105
	1989	25.113	0.170	24.780	25.446
	1990	35.435	1.191	33.100	37.770
	1991	37.383	0.305	36.786	37.981
	1992	35.529	0.138	35.259	35.799
	1993	44.572	1.504	41.623	47.520
	1994	48.959	0.213	48.541	49.376
	1995	51.895	0.844	50.240	53.550
	1996	55.488	0.261	54.976	56.000
	1997	52.989	0.392	52.220	53.758
	1998	55.959	1.174	53.657	58.261
	1999	59.907	0.497	58.934	60.881
	2000	53.785	0.342	53.115	54.454
	2001	51.175	0.308	50.571	51.779
	2002	55.436	0.524	54.409	56.462
	2003	51.251	2.552	46.248	56.254
	2004	28.655	0.234	28.197	29.113
	2005	27.284	0.205	26.882	27.685
	2006	32.063	1.752	28.630	35.497
	2007	52.573	0.196	52.188	52.958
	2008	52.095	0.391	51.329	52.861
	2009	58.050	0.255	57.550	58.551

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2010	54.875	0.178	54.526	55.225
	2011	54.747	0.213	54.329	55.165
JAPAN	1980	66.916	0.148	66.625	67.206
	1981	63.720	0.192	63.344	64.095
	1982	68.408	0.337	67.748	69.067
	1983	64.924	0.306	64.324	65.524
	1984	66.186	0.340	65.520	66.853
	1985	58.331	0.506	57.338	59.323
	1986	53.344	0.464	52.435	54.252
	1987	49.901	0.212	49.486	50.315
	1988	32.839	1.689	29.530	36.149
	1989	28.285	0.133	28.024	28.545
	1990	39.404	1.290	36.875	41.932
	1991	40.581	0.350	39.894	41.268
	1992	39.328	0.125	39.083	39.573
	1993	47.729	1.343	45.096	50.362
	1994	51.376	0.222	50.940	51.811
	1995	55.325	0.781	53.794	56.856
	1996	58.596	0.201	58.203	58.989
	1997	55.291	0.271	54.759	55.823
	1998	57.671	1.052	55.610	59.733
	1999	61.123	0.399	60.341	61.904
	2000	56.509	0.448	55.630	57.388
	2001	53.864	0.585	52.718	55.009
	2002	59.382	0.580	58.246	60.518
	2003	45.883	1.720	42.511	49.255

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2004	30.901	0.229	30.452	31.351
	2005	29.761	0.160	29.447	30.075
	2006	33.606	1.717	30.240	36.972
	2007	54.200	0.177	53.854	54.547
	2008	56.066	0.422	55.239	56.892
	2009	62.609	0.244	62.131	63.086
	2010	56.840	0.129	56.587	57.093
	2011	56.085	0.192	55.709	56.461
KOREA	1980	61.785	0.258	61.279	62.291
	1981	60.694	0.147	60.405	60.982
	1982	64.347	0.264	63.830	64.865
	1983	60.956	0.328	60.314	61.598
	1984	58.193	0.541	57.134	59.253
	1985	55.265	0.177	54.917	55.613
	1986	48.741	0.273	48.205	49.277
	1987	45.231	0.249	44.743	45.718
	1988	29.604	1.512	26.640	32.568
	1989	25.191	0.153	24.890	25.491
	1990	35.049	1.196	32.704	37.394
	1991	37.026	0.264	36.509	37.543
	1992	35.643	0.124	35.400	35.887
	1993	42.011	1.117	39.821	44.201
	1994	47.152	0.268	46.628	47.677
	1995	52.258	0.815	50.660	53.856
	1996	55.396	0.298	54.812	55.980
	1997	51.514	0.180	51.161	51.867

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1998	53.542	0.793	51.988	55.097
	1999	56.951	0.268	56.425	57.476
	2000	54.976	0.180	54.622	55.330
	2001	55.628	0.155	55.325	55.931
	2002	50.317	2.455	45.506	55.128
	2003	7.179	2.226	2.815	11.542
	2004	28.649	0.185	28.286	29.012
	2006	30.733	1.631	27.537	33.929
	2007	51.346	0.226	50.903	51.790
	2008	55.374	0.420	54.551	56.198
	2009	60.948	0.380	60.202	61.694
	2010	54.282	0.066	54.152	54.412
	2011	55.676	0.111	55.459	55.893
	1980	8.402	0.120	8.166	8.638
MEXICO	1981	9.615	0.191	9.240	9.989
	1982	11.544	0.253	11.048	12.039
	1983	10.007	0.322	9.376	10.638
	1984	9.217	0.188	8.848	9.586
	1985	8.112	0.221	7.678	8.545
	1986	7.002	0.113	6.780	7.225
	1987	3.965	0.424	3.133	4.797
	1988	3.011	0.084	2.845	3.176
	1989	3.090	0.083	2.927	3.253
	1990	5.145	0.215	4.725	5.566
	1991	5.759	0.146	5.472	6.047
	1992	5.593	0.116	5.365	5.821

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1993	7.375	0.249	6.886	7.863
	1994	9.556	0.163	9.237	9.875
	1995	12.371	0.341	11.703	13.040
	1996	13.686	0.386	12.929	14.442
	1997	12.865	0.276	12.325	13.406
	1998	14.054	0.201	13.660	14.447
	1999	15.522	0.184	15.162	15.881
	2000	15.711	0.340	15.044	16.378
	2001	15.733	0.261	15.221	16.244
	2002	12.672	1.203	10.314	15.031
	2003	10.625	0.604	9.441	11.808
	2004	6.271	0.124	6.028	6.514
	2005	6.217	0.169	5.885	6.548
	2006	7.662	0.629	6.428	8.895
	2007	17.074	0.316	16.454	17.694
	2008	18.539	0.313	17.927	19.152
	2009	22.502	0.471	21.578	23.425
	2010	19.917	0.310	19.310	20.524
	2011	19.737	0.292	19.165	20.310
	1980	57.700	0.101	57.503	57.897
MIDDLE EAST	1981	63.262	0.297	62.680	63.843
	1982	67.442	0.401	66.657	68.227
	1983	59.352	0.327	58.712	59.992
	1984	60.794	0.285	60.235	61.353
	1985	48.326	0.966	46.433	50.219
	1986	47.577	0.118	47.345	47.808

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1987	30.041	1.725	26.661	33.422
	1988	24.859	0.240	24.388	25.330
	1989	24.318	0.204	23.919	24.718
	1990	33.790	1.137	31.561	36.020
	1991	36.098	0.168	35.769	36.427
	1992	34.479	0.196	34.095	34.863
	1993	40.477	1.118	38.286	42.668
	1994	48.457	0.298	47.873	49.042
	1995	52.742	0.621	51.525	53.959
	1996	55.083	0.289	54.516	55.651
	1997	52.439	0.226	51.995	52.882
	1998	53.328	0.565	52.221	54.435
	1999	55.888	0.354	55.195	56.581
	2000	55.892	0.306	55.294	56.492
	2001	55.005	0.093	54.824	55.187
	2002	51.983	0.510	50.983	52.984
	2003	43.601	1.898	39.882	47.320
	2004	27.410	0.128	27.158	27.661
	2005	33.430	2.276	28.968	37.891
	2006	57.416	0.405	56.623	58.210
	2007	52.009	0.271	51.478	52.539
	2008	52.504	0.491	51.542	53.465
	2009	59.108	0.349	58.425	59.791
	2010	54.172	0.130	53.917	54.426
	2011	52.629	0.156	52.323	52.934
	1980	62.822	0.166	62.497	63.146

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
TAIWAN	1981	65.504	0.420	64.681	66.328
	1982	68.875	0.331	68.227	69.524
	1983	63.758	0.358	63.057	64.459
	1984	63.579	0.267	63.056	64.101
	1985	53.199	0.744	51.740	54.658
	1986	52.150	0.178	51.802	52.499
	1987	33.784	1.872	30.116	37.453
	1988	27.920	0.265	27.401	28.440
	1989	27.132	0.187	26.766	27.499
	1990	36.544	1.112	34.365	38.723
	1991	39.422	0.115	39.196	39.648
	1992	50.793	1.770	47.323	54.263
	1993	54.372	0.556	53.283	55.461
	1994	51.796	0.307	51.194	52.398
	1995	56.035	0.865	54.341	57.730
	1996	58.648	0.304	58.053	59.243
	1997	55.313	0.170	54.979	55.647
	1998	55.644	0.479	54.705	56.582
	1999	59.343	0.366	58.626	60.059
	2000	60.550	0.280	60.001	61.098
	2001	58.700	0.189	58.329	59.070
	2002	56.294	0.153	55.995	56.594
	2003	48.861	2.191	44.567	53.156
	2004	29.749	0.125	29.503	29.995
	2005	36.305	2.277	31.841	40.768
	2006	60.388	0.434	59.538	61.238

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2007	54.088	0.195	53.706	54.470
	2008	53.853	0.399	53.071	54.635
	2009	59.325	0.248	58.839	59.811
	2010	57.020	0.073	56.876	57.164
	2011	53.466	0.138	53.195	53.737

Table A5: Mean values for the Lerner index and standard errors of time and region specific estimates for the US pork exports (corresponding to Table A3)

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
ASEAN	1980	38.390	0.397	37.613	39.167
	1981	17.720	0.495	16.749	18.690
	1982	11.126	0.244	10.647	11.605
	1983	32.467	1.333	29.853	35.080
	1984	17.907	0.868	16.205	19.609
	1985	11.342	0.331	10.692	11.991
	1986	26.017	1.398	23.276	28.758
	1987	17.838	0.919	16.038	19.639
	1988	11.485	0.373	10.754	12.215
	1989	20.919	1.247	18.474	23.363
	1990	16.825	0.843	15.174	18.477
	1991	10.882	0.341	10.214	11.551
	1992	17.725	1.188	15.396	20.054
	1993	16.508	0.802	14.936	18.080
	1994	10.531	0.345	9.854	11.208
	1995	14.311	0.949	12.451	16.171
	1996	15.468	0.605	14.282	16.653
	1997	26.049	2.869	20.425	31.673
	1998	31.474	2.048	27.461	35.487
	1999	15.489	0.586	14.341	16.637
	2000	17.354	1.453	14.507	20.202
	2001	23.389	0.950	21.528	25.250
	2002	14.344	0.412	13.536	15.151

continued . . .

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2003	15.726	1.516	12.754	18.697
	2004	25.267	0.992	23.322	27.211
	2005	14.194	0.342	13.524	14.864
	2006	12.385	0.854	10.713	14.058
	2007	20.882	0.538	19.829	21.936
	2008	12.899	0.204	12.499	13.299
	2009	10.279	0.492	9.315	11.243
	2010	19.814	0.281	19.263	20.365
	2011	12.620	0.063	12.496	12.745
	1980	33.075	0.306	32.476	33.675
	1981	15.860	0.430	15.016	16.704
	1982	10.235	0.231	9.782	10.688
	1983	27.671	1.066	25.583	29.760
	1984	16.121	0.737	14.676	17.566
	1985	10.484	0.316	9.865	11.103
	1986	22.477	1.127	20.268	24.685
	1987	16.066	0.760	14.576	17.556
	1988	10.511	0.349	9.827	11.195
	1989	18.641	1.063	16.557	20.726
	1990	15.223	0.737	13.779	16.667
	1991	9.984	0.315	9.368	10.601
	1992	16.063	1.043	14.019	18.108
	1993	14.985	0.715	13.583	16.386
	1994	25.688	2.344	21.093	30.283
	1995	26.361	1.709	23.010	29.711
	1996	13.976	0.541	12.915	15.036

continued . . .

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1997	22.709	2.362	18.079	27.338
	1998	27.470	1.689	24.160	30.781
	1999	14.157	0.518	13.142	15.173
	2000	15.749	1.236	13.326	18.172
	2001	21.028	0.789	19.482	22.573
	2002	13.186	0.374	12.453	13.919
	2003	14.064	1.257	11.601	16.527
	2004	22.339	0.815	20.740	23.937
	2005	13.010	0.312	12.399	13.621
	2006	11.366	0.737	9.922	12.810
	2007	18.940	0.472	18.014	19.866
	2008	11.874	0.188	11.506	12.243
	2009	9.518	0.426	8.683	10.353
	2010	17.868	0.232	17.412	18.323
	2011	11.561	0.044	11.474	11.647
CANADA	1980	23.472	0.210	23.060	23.884
	1981	11.450	0.323	10.816	12.084
	1982	7.507	0.160	7.192	7.821
	1983	19.991	0.766	18.491	21.492
	1984	11.672	0.519	10.655	12.689
	1985	7.643	0.224	7.205	8.082
	1986	16.297	0.813	14.705	17.890
	1987	11.709	0.546	10.638	12.780
	1988	7.686	0.258	7.180	8.193
	1989	13.659	0.776	12.137	15.180
	1990	11.216	0.554	10.131	12.302

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1991	7.372	0.239	6.904	7.840
	1992	11.867	0.767	10.363	13.370
	1993	10.931	0.507	9.937	11.926
	1994	19.565	1.835	15.968	23.161
	1995	19.941	1.358	17.280	22.601
	1996	10.505	0.407	9.707	11.304
	1997	17.015	1.756	13.573	20.456
	1998	20.561	1.259	18.094	23.029
	1999	10.722	0.387	9.963	11.480
	2000	11.807	0.893	10.056	13.558
	2001	15.645	0.569	14.528	16.761
	2002	9.950	0.280	9.402	10.499
	2003	10.749	0.964	8.858	12.639
	2004	17.212	0.641	15.956	18.468
	2005	9.893	0.237	9.429	10.357
	2006	8.737	0.570	7.620	9.853
	2007	14.616	0.372	13.887	15.345
	2008	11.797	1.347	9.157	14.437
	2009	30.258	0.834	28.624	31.892
	2010	13.597	0.182	13.240	13.954
	2011	8.965	0.037	8.891	9.038
CARIBBEAN	1980	31.690	0.212	31.274	32.107
	1981	16.990	0.406	16.194	17.786
	1982	11.656	0.231	11.202	12.109
	1983	26.741	0.909	24.960	28.522
	1984	17.005	0.673	15.687	18.323

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1985	11.588	0.326	10.950	12.226
	1986	22.550	1.020	20.551	24.550
	1987	16.878	0.719	15.468	18.288
	1988	11.496	0.364	10.783	12.208
	1989	19.265	1.004	17.298	21.233
	1990	16.057	0.718	14.650	17.464
	1991	37.194	3.233	30.858	43.530
	1992	30.887	2.423	26.137	35.636
	1993	15.507	0.667	14.199	16.815
	1994	24.782	2.017	20.829	28.735
	1995	25.774	1.468	22.896	28.651
	1996	15.116	0.566	14.007	16.225
	1997	21.957	1.952	18.130	25.784
	1998	26.234	1.389	23.512	28.956
	1999	15.123	0.527	14.090	16.156
	2000	16.034	1.047	13.983	18.086
	2001	20.941	0.705	19.559	22.323
	2002	13.870	0.382	13.121	14.619
	2003	14.752	1.202	12.396	17.109
	2004	22.914	0.823	21.300	24.528
	2005	13.808	0.331	13.159	14.457
	2006	12.119	0.697	10.752	13.485
	2007	19.477	0.467	18.562	20.392
	2008	15.479	1.424	12.688	18.270
	2009	35.866	0.890	34.121	37.611
	2010	17.951	0.198	17.563	18.338

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2011	12.394	0.038	12.320	12.468
EU(28)	1980	30.726	0.260	30.216	31.235
	1981	17.394	0.362	16.684	18.104
	1982	12.101	0.227	11.657	12.546
	1983	26.432	0.884	24.700	28.164
	1984	17.280	0.603	16.099	18.462
	1985	11.928	0.316	11.309	12.548
	1986	22.507	1.006	20.535	24.479
	1987	17.096	0.680	15.764	18.429
	1988	11.834	0.352	11.143	12.525
	1989	19.275	0.981	17.353	21.197
	1990	16.122	0.661	14.827	17.418
	1991	35.168	2.956	29.374	40.962
	1992	29.759	2.121	25.601	33.916
	1993	15.482	0.576	14.354	16.610
	1994	24.315	1.906	20.579	28.050
	1995	25.490	1.297	22.948	28.033
	1996	15.443	0.535	14.394	16.491
	1997	21.259	1.758	17.813	24.704
	1998	25.312	1.170	23.019	27.606
	1999	15.239	0.489	14.279	16.198
	2000	16.400	1.087	14.269	18.531
	2001	20.933	0.673	19.614	22.253
	2002	14.077	0.362	13.368	14.786
	2003	14.862	1.182	12.545	17.178
	2004	22.639	0.742	21.186	24.093

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2005	20.824	2.247	16.420	25.228
	2006	38.916	1.471	36.033	41.799
	2007	19.291	0.430	18.447	20.134
	2008	15.495	1.355	12.839	18.150
	2009	34.564	0.817	32.962	36.166
	2010	18.066	0.197	17.679	18.453
	2011	12.650	0.045	12.562	12.737
HONG/CHINA	1980	25.140	0.202	24.745	25.536
	1981	14.709	0.282	14.156	15.261
	1982	10.325	0.186	9.960	10.690
	1983	21.964	0.708	20.576	23.352
	1984	14.582	0.502	13.598	15.565
	1985	10.129	0.271	9.598	10.659
	1986	19.012	0.834	17.377	20.647
	1987	14.545	0.595	13.378	15.711
	1988	36.743	2.597	31.654	41.832
	1989	25.688	1.964	21.838	29.538
	1990	13.533	0.545	12.465	14.601
	1991	29.244	2.406	24.529	33.959
	1992	24.660	1.783	21.165	28.154
	1993	13.450	0.521	12.430	14.471
	1994	20.859	1.591	17.741	23.977
	1995	21.777	1.102	19.617	23.937
	1996	13.278	0.464	12.368	14.187
	1997	18.117	1.454	15.268	20.966
	1998	21.541	1.004	19.574	23.509

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1999	13.048	0.428	12.209	13.886
	2000	13.858	0.867	12.158	15.558
	2001	18.214	0.601	17.035	19.392
	2002	12.156	0.316	11.536	12.776
	2003	12.829	0.979	10.911	14.747
	2004	19.405	0.632	18.167	20.644
	2005	17.840	1.928	14.061	21.618
	2006	33.572	1.291	31.041	36.102
	2007	16.528	0.363	15.818	17.239
	2008	13.376	1.116	11.188	15.563
	2009	29.363	0.681	28.029	30.698
	2010	15.896	0.172	15.559	16.232
	2011	11.111	0.044	11.025	11.197
JAPAN	1980	8.909	0.065	8.781	9.037
	1981	5.087	0.097	4.896	5.278
	1982	3.547	0.061	3.427	3.667
	1983	8.008	0.274	7.470	8.545
	1984	5.219	0.195	4.837	5.601
	1985	3.587	0.096	3.399	3.776
	1986	7.144	0.334	6.489	7.799
	1987	5.320	0.230	4.870	5.771
	1988	16.047	1.247	13.604	18.491
	1989	10.296	0.947	8.441	12.152
	1990	5.092	0.210	4.681	5.503
	1991	12.082	1.051	10.022	14.143
	1992	10.064	0.774	8.546	11.582

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1993	5.219	0.207	4.813	5.625
	1994	8.450	0.680	7.118	9.782
	1995	8.831	0.475	7.899	9.763
	1996	5.278	0.192	4.902	5.655
	1997	7.517	0.639	6.264	8.769
	1998	9.044	0.460	8.142	9.945
	1999	5.262	0.179	4.910	5.613
	2000	5.989	0.446	5.116	6.862
	2001	7.891	0.303	7.298	8.484
	2002	11.831	1.821	8.262	15.400
	2003	20.674	1.241	18.241	23.107
	2004	8.316	0.291	7.745	8.887
	2005	7.899	0.943	6.051	9.747
	2006	15.608	0.659	14.317	16.899
	2007	7.154	0.161	6.838	7.470
	2008	6.005	0.537	4.952	7.058
	2009	13.757	0.336	13.099	14.416
	2010	7.257	0.086	7.088	7.425
	2011	4.866	0.025	4.818	4.914
KOREA	1980	16.623	0.087	16.453	16.794
	1981	9.962	0.187	9.596	10.328
	1982	7.130	0.118	6.900	7.361
	1983	14.856	0.473	13.928	15.784
	1984	10.034	0.341	9.366	10.702
	1985	32.738	1.921	28.972	36.504
	1986	18.330	1.444	15.499	21.161

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1987	9.989	0.382	9.239	10.738
	1988	24.544	1.695	21.223	27.866
	1989	17.061	1.256	14.599	19.523
	1990	9.572	0.352	8.881	10.262
	1991	19.641	1.532	16.638	22.645
	1992	16.859	1.102	14.699	19.018
	1993	9.544	0.350	8.857	10.230
	1994	14.285	1.037	12.254	16.317
	1995	15.018	0.695	13.656	16.381
	1996	9.478	0.322	8.847	10.110
	1997	12.892	1.019	10.895	14.890
	1998	15.301	0.714	13.901	16.701
	1999	9.360	0.299	8.775	9.945
	2000	10.257	0.677	8.930	11.583
	2001	13.329	0.457	12.434	14.225
	2002	17.628	2.329	13.063	22.194
	2003	29.552	1.563	26.489	32.616
	2004	13.697	0.429	12.856	14.538
	2005	12.716	1.265	10.236	15.195
	2006	23.230	0.869	21.527	24.934
	2007	11.919	0.233	11.462	12.376
	2008	10.035	0.733	8.599	11.472
	2009	20.823	0.442	19.956	21.689
	2010	11.850	0.139	11.578	12.122
	2011	8.250	0.030	8.192	8.309
MEXICO	1980	24.011	0.135	23.747	24.276

continued . . .

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1981	14.906	0.282	14.354	15.458
	1982	10.908	0.174	10.567	11.249
	1983	21.143	0.624	19.920	22.365
	1984	14.764	0.466	13.851	15.677
	1985	39.898	2.129	35.726	44.071
	1986	24.415	1.546	21.385	27.445
	1987	14.662	0.509	13.665	15.660
	1988	30.585	1.872	26.915	34.255
	1989	22.894	1.371	20.206	25.581
	1990	14.070	0.466	13.156	14.985
	1991	25.627	1.789	22.121	29.133
	1992	22.508	1.241	20.076	24.940
	1993	13.816	0.469	12.897	14.735
	1994	19.609	1.291	17.079	22.140
	1995	20.586	0.869	18.882	22.290
	1996	13.469	0.416	12.653	14.285
	1997	17.748	1.290	15.221	20.276
	1998	20.672	0.869	18.969	22.375
	1999	23.920	2.070	19.862	27.978
	2000	31.285	1.392	28.557	34.013
	2001	18.076	0.577	16.945	19.208
	2002	21.983	2.461	17.159	26.806
	2003	35.078	1.596	31.949	38.206
	2004	18.472	0.516	17.462	19.483
	2005	16.980	1.453	14.133	19.827
	2006	29.013	0.976	27.100	30.925

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2007	16.250	0.285	15.692	16.809
	2008	13.659	0.881	11.933	15.385
	2009	26.276	0.529	25.240	27.313
	2010	15.993	0.160	15.678	16.307
	2011	11.364	0.037	11.291	11.437
OCEANIA	1980	12.212	0.088	12.041	12.384
	1981	7.339	0.141	7.063	7.615
	1982	28.663	1.101	26.504	30.822
	1983	12.872	0.855	11.195	14.548
	1984	7.383	0.246	6.901	7.865
	1985	21.727	1.206	19.364	24.090
	1986	12.846	0.872	11.138	14.554
	1987	7.575	0.279	7.029	8.122
	1988	16.810	1.076	14.701	18.919
	1989	12.191	0.779	10.664	13.717
	1990	7.300	0.254	6.803	7.797
	1991	13.762	0.994	11.814	15.710
	1992	12.093	0.693	10.735	13.451
	1993	7.242	0.267	6.720	7.765
	1994	10.775	0.767	9.271	12.279
	1995	11.236	0.525	10.206	12.266
	1996	7.241	0.236	6.779	7.704
	1997	9.721	0.726	8.298	11.144
	1998	11.366	0.504	10.378	12.354
	1999	14.370	1.452	11.523	17.217
	2000	19.152	1.060	17.073	21.230

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	2001	10.024	0.326	9.385	10.664
	2002	12.613	1.490	9.693	15.533
	2003	20.626	0.984	18.698	22.553
	2004	10.413	0.297	9.831	10.994
	2005	9.687	0.847	8.026	11.347
	2006	16.797	0.572	15.676	17.917
	2007	9.383	0.179	9.032	9.733
	2008	7.777	0.505	6.787	8.766
	2009	15.212	0.294	14.637	15.788
	2010	9.371	0.103	9.169	9.573
	2011	6.513	0.030	6.454	6.571
TAIWAN	1980	21.049	0.125	20.805	21.293
	1981	13.333	0.244	12.854	13.812
	1982	41.280	1.403	38.531	44.029
	1983	21.298	1.042	19.257	23.340
	1984	13.337	0.383	12.586	14.089
	1985	32.429	1.603	29.288	35.569
	1986	21.148	1.106	18.980	23.315
	1987	13.505	0.427	12.667	14.343
	1988	25.886	1.452	23.040	28.731
	1989	19.866	1.040	17.827	21.906
	1990	12.806	0.401	12.020	13.592
	1991	21.762	1.396	19.026	24.497
	1992	19.520	0.957	17.644	21.396
	1993	12.400	0.404	11.608	13.192
	1994	17.498	1.122	15.298	19.698

continued ...

Region	Year	Mean Lerner	Std.Err.	Lower (95%)	Upper (95%)
	1995	18.230	0.734	16.791	19.669
	1996	31.832	3.322	25.320	38.344
	1997	36.236	2.374	31.583	40.888
	1998	18.114	0.717	16.709	19.519
	1999	21.353	1.805	17.815	24.890
	2000	27.584	1.253	25.128	30.041
	2001	16.385	0.494	15.416	17.354
	2002	19.285	1.920	15.523	23.047
	2003	29.704	1.267	27.221	32.187
	2004	16.512	0.424	15.681	17.343
	2005	15.092	1.121	12.895	17.288
	2006	24.600	0.720	23.189	26.010
	2007	14.952	0.268	14.426	15.478
	2008	12.380	0.692	11.024	13.736
	2009	22.708	0.384	21.955	23.461
	2010	14.716	0.150	14.422	15.011
	2011	10.452	0.033	10.387	10.517