THE IMPACT OF PIGMEAT IMPORTS ON AUSTRALIAN PIGMEAT PRICES

A report prepared for
Australian Pork Limited
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CONTENTS

ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey-Fuller test
AIC	Akaike Information Criterion
HC	Hannan-Quinn Criterion (HQ)
IRF	Impulse Response Function
OLS	Ordinary Least Squares
PC	Productivity Commission
SC	Schwarz Criterion (SC)
SUR	Seemingly Unrelated Regression
VAR	Vector Autoregression
VDC	Variance Decomposition
VMA	Vector Moving Average
WTO	World Trade Organisation
cwe	carcase weight equivalent
cwt	carcase weight

EXECUTIVE SUMMARY

This report examines the impacts of imports of frozen pigmeat within subheading 0203.29 of the Australian Customs Tariff on domestic pig and pigmeat prices. Specifically, the report addresses the following questions:

Do frozen pigmeat import volumes within subheading 0203.29 significantly influence
1) the domestic contract price for baconers?
2) the domestic wholesale price for baconers?

An additional aim of the analysis is to determine if the same classification of imported pigmeat adversely affects Australian production of pigmeat. Two separate timeframes are analysed in the study. The first period is from January 1995 to August 2007. The second period covers the most recent five years data from September 2002 to August 2007.

Six variables are chosen for inclusion in the study based on theoretical considerations, previous literature and data availability. The variables are:

1. Imports of pigmeat 'meat of swine, frozen' into Australia, tariff subheading 0203.29, from Canada, Denmark and the USA, tonnes carcase weight equivalent
2. The national average baconer contract price, 60-75 kg pigs, cents/kg carcase weight
3. The Sydney wholesale carcase price, GI bacon 60-75 kg, cents/kg
4. Production of pigmeat in Australia, tonnes carcase weight
5. Production of pigmeat in NSW, tonnes carcase weight
6. The bilateral exchange rate between the USA and Australia

All data represent monthly averages. The price and quantity data series were provided by Australian Pork Limited and the bilateral exchange rate data were obtained from the Reserve Bank of Australia. Seasonal and trend variables are also specified in the analysis.

Time series econometrics techniques are used to statistically test whether past values of pigmeat imports can be used to explain movements in domestic pigmeat prices and production. Granger and Sims causality test results provide strong evidence of causality among the variables. The interrelationships among the variables are modelled within a vector autoregression (VAR) framework.

Impulse response functions are used to track the responsiveness of domestic prices over time to a 1 per cent increase in total pigmeat imports. The results from both sample periods display similar significant downward movements in prices. When the full sample set of data are examined, the accumulated impacts on domestic prices are shown to be considerable. In response to a 1 per cent increase in the quantity of imported pigmeat, the contract price of pigs is estimated to fall by around 0.25 per cent after one year and a little over 0.30 per cent at the end of two years. Similar results are found for the wholesale price, with falls of 0.23 per cent after one year and 0.29 per cent after two years. The magnitudes of the price changes are even greater when the analysis is confined to the most recent five years data. Around nine months after the shock is implemented, both the contract price and wholesale price are approximately 0.42 per cent below their initial values.

Variance decomposition is a technique used to determine the proportions of the changes in the dependent variables that are attributable to the other variables in the model. Hence, it provides a measure of how influential one variable is in determining the amount of change in another

variable. The variance decompositions of the contract price and the wholesale price imply that the explanatory relationship of pigmeat imports on domestic prices is strong. The influence of pigmeat imports on domestic pigmeat prices appears even more dominant over the most recent sample period, reaffirming the results from the impulse responses.

The results from the analysis give no indication that pigmeat imports cause a decline in domestic pigmeat production. Contrary to theoretical expectations, the production response to an increase in the level of pigmeat imports is positive. Although imports should exert a negative influence on domestic production, the effect is more than likely outweighed by positive supply pressure from a combination of other factors.

Two econometric studies were commissioned by the Productivity Commission in the 1998 inquiry into safeguard action against pigmeat imports. The report by Griffith (1998) indicated there was a strong possibility that imports affect domestic prices. The IRIC/Muresk (1998) report did not find any evidence of a link from import volumes to prices. One of the reasons highlighted for the ambiguities in the results was the lack of adequate data. The domestic market share of imports over the data period examined was extremely small, making it difficult to measure their impact. The results of the current study are based on a much longer sample period than the data sets used in the 1998 studies. Since then, import market share has increased markedly in comparison to import market share in the earlier period estimations.

This report finds convincing evidence of a significant causal relationship between the level of imports of pigmeat into Australia and the domestic contract bacon price received by pig producers. The report also finds clear evidence of a significant causal relationship between the level of imports of pigmeat into Australia and the domestic wholesale bacon price. Increased levels of pigmeat imports are shown to have a substantial negative impact on both domestic prices. The impacts appear more severe over the past five years indicating that the relationships between imports and domestic prices have intensified over time. It seems reasonable to conclude that impacts on the domestic market were negligible when import volumes were small and irregular in supply. However, the adverse effects on domestic pig and pigmeat prices have become more evident as import volumes have increased.

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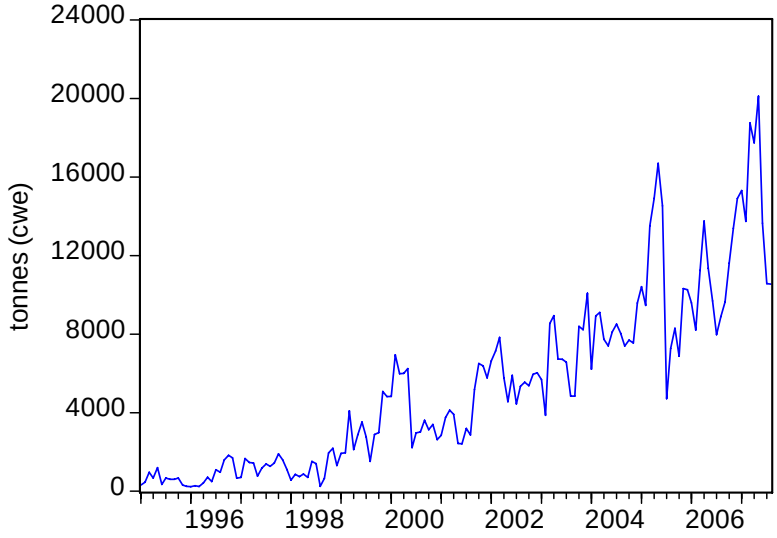
1. Introduction

In October 2007 the Australian Government announced that an inquiry is to be undertaken by the Productivity Commission (PC) to determine if there is a justifiable case for safeguard action against imports of frozen pigmeat within subheading 0203.29 of the Australian Customs Tariff (Productivity Commission 2007). Imports of frozen, uncooked pigmeat began arriving in Australia from Canada in July 1990. Boning of pigmeat prior to export has been an additional import requirement since 1992. Subsequent amendments to quarantine regulations have allowed import access to frozen, boned and uncooked pigmeat from Denmark in 1997 and the USA in 2004. Almost all frozen pigmeat imports within tariff subheading 0203.29 originate from these three countries.

The Australian pork industry contends that frozen pigmeat imports suppress domestic farm-gate prices and displace local product in the bacon, ham and smallgoods markets. Figure 1 graphs monthly imports of pigmeat within subheading 0203.29 from 1995 to 2007. Quite clearly there is an upward trend in the quantity of imported pigmeat entering Australia. Imported pigmeat within this classification increased from an average 460 tonnes (cwe) per month in 1995/96 to an average 13,800 tonnes (cwe) per month in 2006/07. Import levels reached their highest peak in May 2007 at a little over 20,000 tonnes (cwe). The same inference can not be made with respect to domestic pigmeat prices received by pig producers. As Figure 2 indicates, there is no evident trend in the domestic contract price for baconers over the same period of time.

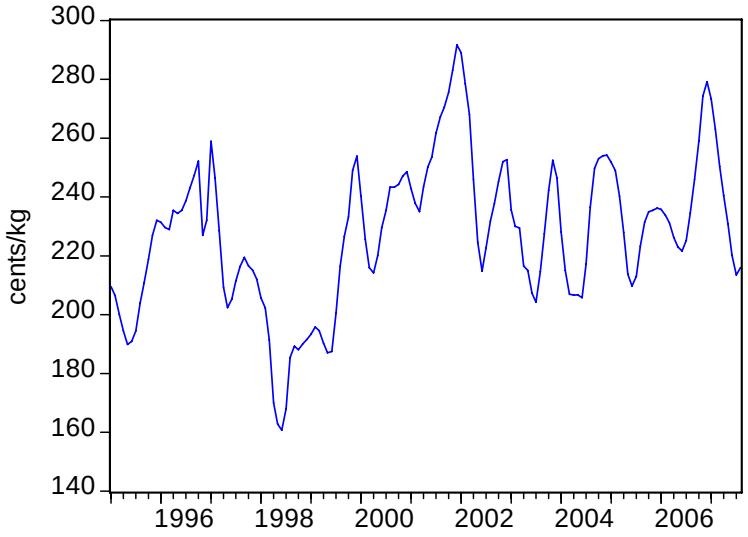
The main aim of this report is to test if there is a statistically significant impact on domestic pigmeat prices from imported pigmeat volumes. Specifically, the report addresses the following questions:
Do frozen pigmeat import volumes within subheading 0203.29 significantly influence
1) the domestic contract price for baconers?
3) the domestic wholesale price for baconers?

Figure 1: Monthly Imports of Pigmeat within Subheading 0203.29: 1995-2007



Source: Australian Pork Limited

Figure 2: Monthly Average Baconer Contract Price: 1995-2007



Source: Australian Pork Limited

A complementary aim of the analysis is to determine if imports of pigmeat adversely affect domestic production of pigmeat. One of the requirements for safeguard action under WTO provisions is that there must be evidence of an increase in the quantity of imports of pigmeat either in absolute terms or relative to production (Productivity Commission 2007). The most recent five years data is proposed as an appropriate timeframe to assess such changes (Sykes 2003, cited in Productivity Commission 2007). The volumes of Australian pigmeat production and pigmeat imports within tariff subheading 0203.29 for the five year period 2002/03 to 2006/07 are listed in Table 1.

Table 1: Domestic Production and Imports of Pigmeat (0203.29): 2002/03 - 2006/07

Year	Domestic Supply of Pigmeat (tonnes cwt)	Supply of Pigmeat Imports (tonnes cwe)	Total Supply of Pigmeat [a] (tonnes cwe)	Imports/Total Supply (%)
2002/03	419.6	73.2	492.8	14.8
2003/04	405.9	90.4	496.3	18.2
2004/05	388.6	128.3	516.9	24.8
2005/06	388.9	111.6	500.5	22.3
2006/07	381.9	165.7	547.6	30.2

[a] Domestic supply of pigmeat plus supply of pigmeat imports (0203.29)
Source: Australian Pork Limited

With the exception of 2005/06, import volumes have been successively increasing while domestic production of pigmeat has been in decline. In 2006/07, imports of pigmeat as a proportion of total supply were double the proportion in 2002/03. The share of pigmeat imports under subheading 0203.29 accounted for just over 1 per cent of the total supply in 1995/96. In 2006/07 imports of pigmeat were approximately 30 per cent of total supply.

The impact of pigmeat imports on domestic prices and production is examined over two distinct timeframes. The first covers a sample period from January 1995 to August 2007. The second period corresponds to the most recent five years data from September 2002 to August 2007.

2. Methodology

Time series econometrics techniques are used to statistically test for evidence of a relationship between domestic pigmeat prices and pigmeat imports. Causality between two variables is examined via the Granger and Sims causality tests, respectively. Granger (1969) causality is said to exist if, in addition to past values of *y*, the inclusion of past values of *x* in the regression equation improve the prediction of the current variable *y*. In general, an equation of the following form is estimated to determine if *x* causes *y* using the Granger approach:

$$y_t = \delta_0 + \delta_1 y_{t-1} + \cdots + \delta_l y_{t-l} + \alpha_1 x_{t-1} + \cdots + \alpha_l x_{t-l} + u_t$$

An F test is conducted for the joint hypothesis:

$H_0 : \alpha_1 = \alpha_2 = \cdots = \alpha_l = 0$ (*x* does not Granger cause *y*)

If the *x* coefficients are jointly different from zero the null hypothesis is rejected in favour of the alternate hypothesis that there is evidence of causality from *x* to *y*. Therefore, the equation's predictive capacity is enhanced through the inclusion of past values of *x*.

The Sims (1972) causality test differs from Granger's test in that the lagged dependent *y* variables are omitted from the regression equations. In this case *y* is regressed on current, past and lead values of the *x* series. If we are interested in finding out if *x* causes *y* using the Sims approach, the estimated equation is of the form:

$$y_t = \alpha_0 x_t + \alpha_1 x_{t-1} + \cdots + \alpha_l x_{t-l} + \beta_1 x_{t+1} + \cdots + \beta_k x_{t+k} + u_t$$

As with the Granger approach, an F test is conducted for the following joint hypothesis:

$H_0 : \beta_1 = \beta_2 = \cdots = \beta_k = 0$ (*x* does not Granger cause *y*)

If the null hypothesis is rejected, there is evidence to suggest that past values of *x* influence *y*.

The Granger and Sims causality tests examine whether the past values of pigmeat imports can be used to explain movements in domestic pigmeat prices and production. These techniques enable the identification of such relationships and if the causality is unidirectional or bilateral. Because both approaches test for pairwise causality, other possible causal relationships are excluded from the procedures. The choice of causality test is open to conjecture (see Bishop 1979; Zellner 1979) though, as pointed out by Griffith (1998), published evidence suggests a preference for the Granger method. However, the use of causality testing in this study is mainly for justification in the selection of a Vector Autoregression Model (VAR) to examine the interrelationships of the variables. In VAR all of the variables are considered endogenous. Hence, the main purpose of running the Granger and Sims causality tests is to determine if any feedback effects exist among the variables.

The VAR method has been used for analysing the dynamic impacts of random disturbances on a system of endogenous variables since the influential work of Sims (1980). In this approach, each variable is explained by its own lagged values and the lagged values of all the endogenous variables included in model. In contrast to the pairwise Granger and Sims causality tests, the VAR framework can be used to examine the causality between all the

variables of concern. The appropriate lag length of the VAR is determined using optimum lag length selection criteria such as the Akaike Information Criterion (AIC), Schwarz Criterion (SC) or Hannan-Quinn Criterion (HQ). Short run dynamics as well as long run relationships can be investigated within the VAR framework through the use of impulse response functions (IRF) and variance decomposition techniques (VDC).

The general form of the VAR is given below:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + ... + \beta_p y_{t-p} + \varepsilon_t \qquad (1)$$

where, y_t is a vector containing each of the endogenous variables included in the VAR, β_0 is a vector of intercept terms, β_i is a matrix of coefficients to be estimated and ε_t is a vector of innovations that are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables.

Due to the dynamic structure of the VAR, a shock to one variable is conveyed to all of the endogenous variables in the model. In order to understand this it is necessary to express the variables in terms of the current and past values of the innovations. This can be achieved by realising that all autoregression representation can be written as a moving average process. Using Sims's (1980) method, moving average representation of equation (1) in terms of innovations can be written as in equation (2), where the coefficients δ_i are the IRF.

$$y_t = \sum_{i=0}^{\infty} \delta_i \varepsilon_{t-i} \qquad (2)$$

The IRF trace the responsiveness of the dependent variables in the VAR to a shock in the current value of one of the VAR errors (Stock and Watson 2001). This representation is useful to examine the interaction between endogenous variables and to trace out the time path of various shocks.

The proportion of the movements in a variable due to its own shocks, relative to shocks to other variables, can be measured using VDC techniques. Separation of this type explains the interactions among the series and determines the relative importance of each random innovation in affecting the variables in the VAR.

3. Variables and Data

Six variables were chosen for inclusion in this analysis based on theoretical considerations, previous literature and data availability. Griffith and Chang (2000) used similar variables to study the relationships between imported pigmeat and prices in the domestic pigmeat market, though the methodology they employed was different. In order to control for possible non linearity and for ease of non stationarities, all of the variables are transformed into natural logs. The variables are defined as follows:

LIMPO: imports of pigmeat 'meat of swine, frozen' into Australia, tariff subheading 0203.29, from Canada, Denmark and the USA, tonnes carcase weight equivalent, January 1995 to August 2007
LAFPP: national average baconer contract price, 60-75 kg pigs, cents/kg carcase weight, January 1995 to August 2007

LAWP: Sydney wholesale carcase price, GI bacon 60-75 kg, cents/kg, January 1995 to August 2007
LAUSPR: production of pigmeat in Australia, tonnes carcase weight, January 1995 to August 2007
LNSWPR: production of pigmeat in NSW, tonnes carcase weight, January 1995 to August 2007
LEXR: bilateral exchange rate between the USA and Australia, $US/$AUS, January 1995 to August 2007

The VAR analyses for the two sample periods include all six variables listed above. Imported pigmeat competes with domestic pigmeat used in the manufacture of bacon, ham and smallgoods. The majority of domestic pigmeat supplied to the manufacturing industry comprises baconer pigs. Because most pigs in Australia are sold on a contract basis (Sheales, Apted and Ashton 2004, p.17), a national average contract price for baconers was chosen as representative of the farm price for baconers. Data availability on wholesale carcase prices was limited to Sydney averages. Consequently, NSW pigmeat production data were included in the model in addition to Australian production of pigmeat. Exchange rate fluctuations are an important determinant of profitability and competitiveness. Appreciation of the Australian dollar reduces Australia's export competitiveness and increases domestic demand for imports. A USA/Australian bilateral exchange rate variable was added to the model. From July 2006 to June 2007 the Australian dollar has appreciated by approximately 12 per cent against the USA dollar. Seasonal and trend variables were also specified in the model. Seasonality is evident in historical pig prices, with a peak in prices usually occurring around December as manufacturers increase demand prior to Christmas (Productivity Commission 2005). All price and quantity data series were provided by Australian Pork Limited. The bilateral exchange rate data were obtained from the Reserve Bank of Australia.

All data represent monthly averages. For consistency with domestic production data, which is specified in carcase weight, import volumes were converted from shipped weight to carcase weight equivalent volumes. Middle cuts were converted using a factor of 0.8 (Heilbron, S. 2007, pers. comm., 2 November) while all other cwe volumes of boneless, frozen meat, including leg and shoulder cuts, were estimated using a 0.56 conversion factor (APL 2007, pers. comm., 2 November). Information on the volumes of imported meat by cut prior to 2001 was not available. The average percentages of the various cuts of meat from Canada, Denmark and the USA for the period January 2001 to August 2007 were used to approximate the pre 2001 cwe volumes originating from those countries. Summary statistics for the variables in the model are listed in Appendix Table 1.

4. Model Estimation

Standard procedure dictates the use of an information criterion to determine the selection of the appropriate distributed lag length. The information criterion provides a measure of the trade-off between the goodness of fit and complexity of the model. The Schwarz Criterion (SC) is used here in preference to the Akaike Information Criterion (AIC) or the Hannan-Quinn Criterion (HQ) as larger penalties are imposed for additional coefficients. More parsimonious models are recommended by the SC with a suggested optimum lag length of one compared to a lag length of three for both the AIC and HQ. The results of the VAR lag order selection criteria are presented in Appendix Table 2.

When conducting time series estimation the data series should be checked for unit roots to verify VAR stability (Enders 2004). If a unit root exists, the series is considered as non-

stationary. This is often the case for monthly commodity prices (Grant et al. 1983). The Augmented Dickey-Fuller (ADF) test is used to verify the stationarity of each variable. Results of the tests are given in Appendix Table 3. With the exception of the farm price (LAFPP), all series were found to contain a unit root. This raises the question of whether the data series' should be differenced appropriately to achieve stationarity. Sims (1980), and others (e.g. Pierce 1977; Stock and Watson 2001), have shown that vital information of long run properties of the data can be lost through differencing. Therefore, we decided to use levels rather than first differences in our estimations. The existence of unit roots is not problematic if the VAR is stable. Instability of the VAR implies that certain results such as impulse response standard errors are not valid. The results of the VAR stability test are provided in Appendix Table 4. All characteristic roots in this VAR have modulus less than one and lie inside the unit circle. Hence, the VAR is stable and the IRF standard errors are sound.

Representation of the equations in VAR estimation can be in structural form, reduced form or recursive form (Stock and Watson 2001). The reduced form equations used in this analysis express each of the variables as a function of their own lag values, the lag values of all the other variables and an uncorrelated error term. For example, imported pigmeat (LIMPO) is explained by its own lagged values and the lagged values of the other variables included in the VAR. With this type of specification, endogenous bias is not a concern as the method produces consistent estimates. Contemporaneous correlation of the error term does not cause a statistical problem in this setting as all the equations contain identical explanatory variables. The model is simply a case of seemingly unrelated regression (SUR) and is estimated using ordinary least squares regression (OLS). Controlling for seasonality and trend in the VAR means there are nine coefficients in each equation, including the intercept, and a total of 54 coefficients in the VAR. The econometric package Eviews was used to estimate the VAR and output from the model is given in Appendix Table 5.

5. Granger and Sims Causality Test Results

The results of the Granger and Sims causality tests for the sample period 1995 to 2007 are presented in Table 2 and Table 3, respectively. The main focus is on the causality between pigmeat imports and domestic pigmeat prices, and between pigmeat imports and domestic pigmeat production.

Table 2: Pairwise Granger Causality Tests, Sample Period 1995:1 - 2007:8

Null Hypothesis:	Obs	F-Statistic	Probability
IMPO does not Granger Cause AFPP	151	2.73126	0.10052
AFPP does not Granger Cause IMPO		8.56631	0.00397
IMPO does not Granger Cause AUSPR	151	11.5412	0.00087
AUSPR does not Granger Cause IMPO		4.41855	0.03724
IMPO does not Granger Cause AWP	151	0.12872	0.72028
AWP does not Granger Cause IMPO		13.3165	0.00036
IMPO does not Granger Cause EXR	151	5.51776	0.02015
EXR does not Granger Cause IMPO		0.15222	0.69699
NSWPR does not Granger Cause IMPO	151	0.99468	0.32023
IMPO does not Granger Cause NSWPR		3.05251	0.08269

Table 3: Pairwise Sims Causality Tests, Sample Period 1995:1 - 2007:8

Null Hypothesis:	Obs	F-Statistic	Probability
IMPO does not Granger Cause AFPP	151	17.48938	0
AFPP does not Granger Cause IMPO		1.11995	0.2917
IMPO does not Granger Cause AUSPR	151	1.18789	0.2775
AUSPR does not Granger Cause IMPO		15.54879	0.0001
IMPO does not Granger Cause AWP	151	25.04632	0
AWP does not Granger Cause IMPO		0.04713	0.8284
IMPO does not Granger Cause EXR	151	0.174227	0.677
EXR does not Granger Cause IMPO		11.9277	0.0033
NSWPR does not Granger Cause IMPO	151	0.211851	0.646
IMPO does not Granger Cause NSWPR		5.491	0.0205

The Granger causality test results indicate the existence of causality in all instances. However, only the first three pairwise tests conform at the 1 per cent level of significance. The Sims causality test results also indicate there are causal relationships between pairwise variables but the direction of causality is opposite to the Granger results.

The contradictory results of the two tests likely stems from the differences in their estimation. Recall that the Granger test includes lagged values of both the *x* and *y* variables whereas the Sims test is solely based on the current, past and future values of the *x* series. In summary, both test results provide strong evidence of pairwise causality among the variables selected in the model and suggest that VAR is an appropriate method to model the interrelationships.

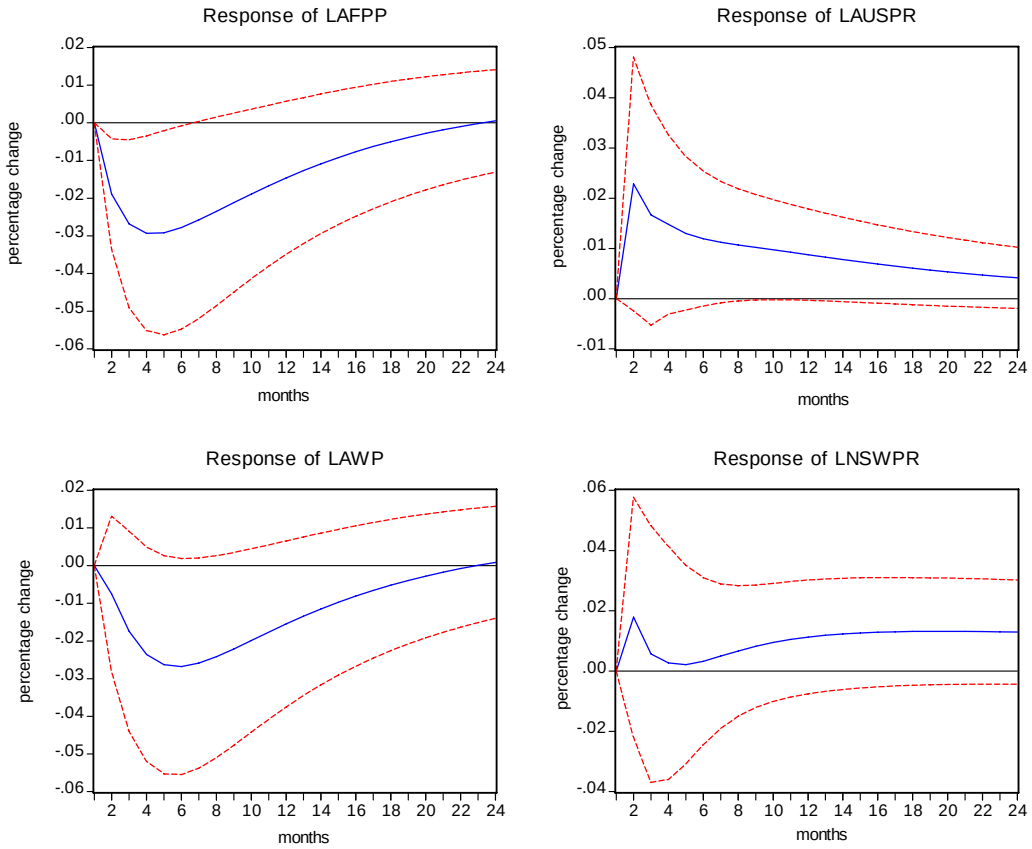
6. VAR Results, Sample Period 1995:1 - 2007:8

The responses of the domestic price and production variables to a one percentage point increase in total pigmeat imports are examined using IRF and forecast error VDC generated from the estimated VAR.[1] As discussed in Section 2, IRF are obtained using vector moving average representation of the VAR whereby each equation in the VAR is expressed in terms of the current and past values of the innovations. The IRF for each of the variables of interest are plotted in the following four diagrams in Figure 2, with ± 2 standard errors represented by the two dotted lines. The responses are shown for a one percentage point increase in total pigmeat imports.

The results from the model suggest that the farm pig price (LAFPP) and the wholesale price (LAWP) react to the increase in pigmeat imports. The IRF of the farm pig price (LAFPP) and the wholesale pigmeat price (LAWP) depicted in Figure 2 display a significantly negative impact on price. The responses are immediate and persistent as it takes approximately two years for the impacts to disappear. This indicates a strong causal relationship between the level of imported pigmeat and the two domestic prices.

[1] Enders (2004, pp. 264-290) provides an excellent treatment of the technical details of VAR, IRF and VDC.

Figure 2: Responses of Prices and Production to 1% Increase in Pigmeat Imports



Somewhat contrary to expectations, the production responses are positive. The IRF for Australian production (LAUSPR) and NSW production (LNSWPR) suggest that both responses remain positive over the two year time frame plotted, with little indication of returning to the base line. Although imports should exert a negative influence on domestic production, the effect is more than likely outweighed by positive supply pressure from other sources, such as increased productivity, economies of scale and export market prices. Hence, over the entire sample period, imports appear to have little influence on regional or national pigmeat production. The graphical illustrations presented in Figure 2 are also shown in tabular form in Appendix Table A6.

The accumulated impacts on domestic prices and production in response to the 1 per cent increase in imports are provided in Table 4. The results suggest that the decrease in the farm pig price (LAFPP) is substantial, around 0.25 per cent after one year and a little over 0.30 per cent at the end of two years. The accumulated response of the wholesale pigmeat price (LAWP) follows a similar pattern to the farm pig price, although the overall effect is marginally less in magnitude. In terms of production, the accumulated impacts in the short run are small and positive. For example, Australian production (LASUPR) increases by approximately 0.13 per cent one year after the initial shock. As previously mentioned, the positive production responses may be due to a combination of other factors.

The importance of the interactions among the variables can be examined using VDC. Since reduced form equations were chosen in the estimation of the VAR, orthogonalized innovations, obtained from Choleski Decomposition, were used in the VDC analysis. The

VDC of the farm price (LAFPP) is reported in Table 5. The wholesale pigmeat price (LAWP), and the NSW (LNSWPR) and Australian (LAUSPR) pigmeat production VDC are listed in Appendix Tables 7, 8 and 9, respectively. In each table, the percentages of the forecast variance due to each innovation are given in columns three through to eight. The sum of each row is equal to 100.[2]

Table 4: Accumulated Impulse Responses, Sample Period 1995:1 - 2007:8

Period	LAFPP	LAWP	LNSWPR	LAUSPR
1	0	0	0	0
2	-0.01891	-0.00754	0.017874	0.022814
3	-0.0457	-0.02497	0.023524	0.039462
4	-0.07501	-0.04852	0.02624	0.054223
5	-0.1042	-0.07486	0.028369	0.067202
6	-0.13199	-0.10168	0.031617	0.079124
7	-0.15777	-0.12757	0.036565	0.090346
8	-0.1813	-0.15176	0.043257	0.101032
9	-0.20249	-0.17388	0.051493	0.111236
10	-0.2214	-0.19377	0.061003	0.120963
11	-0.2381	-0.21144	0.071521	0.130206
12	-0.25273	-0.22694	0.082817	0.138959
13	-0.26542	-0.24038	0.094702	0.147224
14	-0.27631	-0.25191	0.107026	0.155009
15	-0.28554	-0.26164	0.119671	0.16233
16	-0.29325	-0.26973	0.132545	0.169205
17	-0.29955	-0.2763	0.145573	0.175656
18	-0.30459	-0.28148	0.158697	0.181707
19	-0.30846	-0.2854	0.17187	0.187382
20	-0.31128	-0.28818	0.185053	0.192703
21	-0.31314	-0.28991	0.198214	0.197695
22	-0.31414	-0.29069	0.211326	0.202378
23	-0.31435	-0.29062	0.224366	0.206775
24	-0.31386	-0.28979	0.237314	0.210904

The fourth column of Table 5 shows that the forecast variance of (LAFPP) in the first period is almost entirely due to its own innovation. From period two onwards, the innovations of the other variables contribute successively more to the forecast variance. After nine months the contribution of pigmeat imports in the VDC is significant at 13 per cent, and much larger in comparison to the innovation shares of the other variables. For instance, the contribution of the exchange rate is just 1 per cent at the same point in time. The imported pigmeat contribution remains relatively constant through to the end of the two year period, maintaining its dominant status throughout.

Appendix Table 7 reports a similar finding with respect to the importance of pigmeat imports in the VDC of the wholesale pigmeat price (LAWP), contributing approximately 10 per cent at the end of twelve months and changing little by the end of two years.

The VDC of NSW production (NSWPR) implies that the explanatory relationship of pigmeat imports on domestic production is rather weak, reaffirming earlier results from the impulse responses. Total pigmeat imports account for just 2 per cent of NSW production VDC after

[2] Each row may not sum exactly to 100 as the seasonal and trend variables have been removed from the presentation.

twelve months, increasing slightly to 2.5 per cent after two years (see Appendix Table 8). The importance is stronger (8 per cent) with respect to Australian production (AUSPR), again consistent with previous conclusions, but it is still a relatively small proportion of the forecast VDC (see Appendix Table 9).

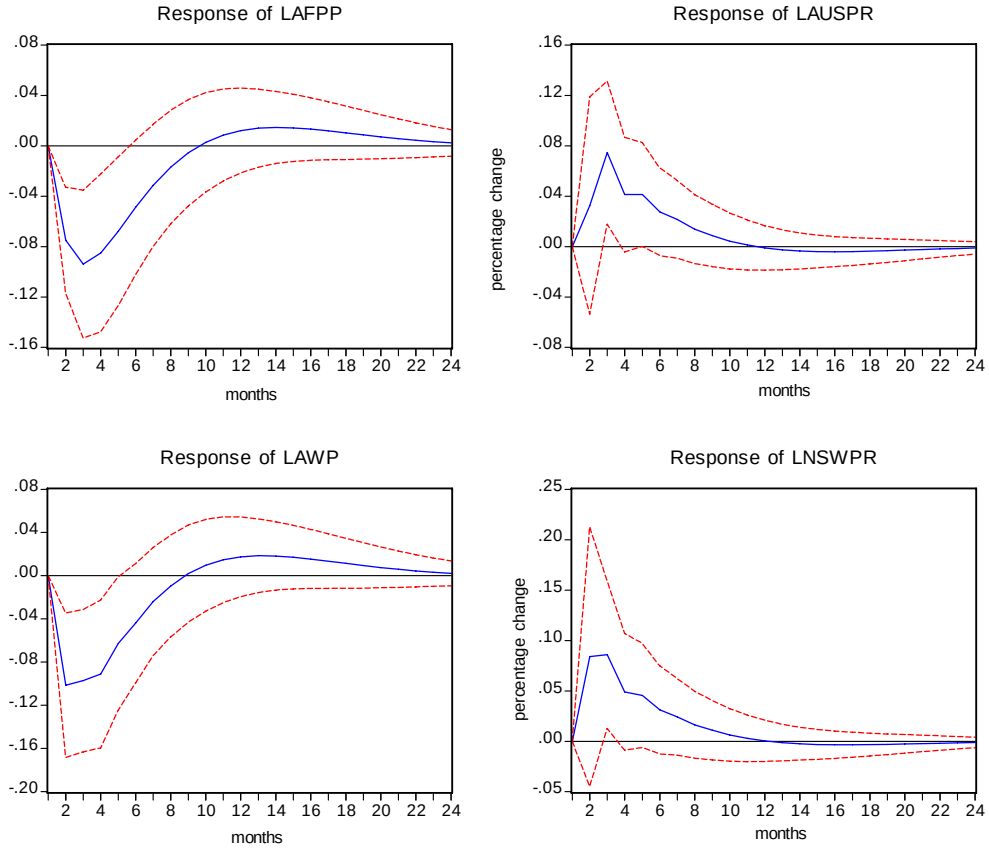
Table 5: Variance Decomposition of LAFPP, Sample Period 1995:1 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.349799	2.126052	97.87395	0	0	0	0
2	0.409881	5.211303	92.51279	0.644432	0.900333	0.016449	0.013981
3	0.425348	7.796398	87.91647	1.20222	1.826457	0.072827	0.030593
4	0.431175	9.664781	84.44308	1.651823	2.463429	0.167251	0.105074
5	0.434376	10.97136	81.85511	2.000355	2.871282	0.298075	0.214341
6	0.436839	11.88064	79.89756	2.263921	3.134216	0.464359	0.337621
7	0.438987	12.51249	78.3832	2.458771	3.309531	0.665253	0.461849
8	0.440901	12.94875	77.18311	2.599122	3.431611	0.899724	0.579901
9	0.442599	13.24495	76.20855	2.6968	3.520473	1.166432	0.6884
10	0.444099	13.43932	75.39745	2.761425	3.587779	1.463697	0.786149
11	0.445423	13.5587	74.70561	2.800734	3.640409	1.7895	0.873142
12	0.446596	13.62235	74.10107	2.820915	3.6825	2.141518	0.94997
13	0.447641	13.64443	73.56052	2.82689	3.7166	2.517171	1.017486
14	0.448581	13.6355	73.06685	2.822564	3.744332	2.913684	1.076618
15	0.449436	13.60361	72.60748	2.81102	3.76677	3.328151	1.128273
16	0.450222	13.55494	72.17325	2.794679	3.784665	3.757597	1.173296
17	0.450953	13.4943	71.75753	2.77543	3.798572	4.199044	1.21245
18	0.45164	13.42546	71.35558	2.754732	3.80893	4.649563	1.246416
19	0.452292	13.35137	70.96415	2.733697	3.816105	5.106329	1.275798
20	0.452917	13.27434	70.58105	2.713158	3.820419	5.566657	1.301126
21	0.453518	13.19618	70.20489	2.693722	3.822163	6.02804	1.322872
22	0.454102	13.1183	69.83492	2.675817	3.821607	6.48817	1.341452
23	0.45467	13.04176	69.4708	2.659724	3.819004	6.944956	1.357234
24	0.455225	12.96737	69.11248	2.645614	3.814591	7.39653	1.370546

7. VAR Results, Sample Period 2002:9 - 2007:8

The VAR analysis was also conducted over the most recent five year data period. The model contained the same set of explanatory variables to enable consistency in the estimation of the impacts of imports on domestic prices and production, and to provide a comparison of the two sample periods. The outcomes were examined using IRF and VDC. Diagrammatic representation of the impulse responses are illustrated in Figure 7. The domestic price and production variables exhibit similar behaviour to their counterparts in the full sample period estimation but the magnitude of the reactions is significantly greater. In addition, the responses of both the farm price of pigs (LAFPP) and the wholesale pigmeat price (LAWP) are much more intense than when they were estimated over the longer sample set. The short-run impacts are prominent but phase out by the end of 12 months. The production responses to a 1 per cent increase in imports are still positive but, as is the case with prices, the impacts are more condensed. Both NSW and Australian production revert back to the base line after 12 months. The impulse responses for each of the variables are listed in Appendix Table 10.

Figure 7: Responses of Prices and Production to 1% Increase in Pigmeat Imports



The accumulated responses, reported in Table 6, peak at around one year after the initial shock. It is clear that the impacts from a 1 per cent increase in pigmeat imports are substantially stronger than the results obtained for the longer sample period. By the end of month eight, the farm pig price (LAFPP) is 0.42 per cent lower than its initial value, compared to 0.18 per cent at the same period of time using the longer sample. The negative effect on the wholesale price (LAWP) is even more noticeable over the same eight month horizon, 0.43 per cent compared to 0.04 per cent in the longer sample.

The findings are reinforced by the VDC results. Column three of Table 7 shows that imports contribute around one-third of the forecast error variance of the farm pig price (LAFPP) four months after the initial shock. This was not the case under the full sample results where imports contributed to 13 per cent of the forecast variance of the farm pig price after two years had elapsed.

The stronger influence of imports is also evident in the VDC of the wholesale price (LAWP) in Appendix Table 11, accounting for 29 per cent of the forecast variance after four months. At the same point in time in the full sample, the contribution of imports was only 5 per cent.

Unlike in the full sample, the VDC of Australian and NSW production in Appendix Tables 12 and 13 indicate that imports do exhibit some degree of predictive capability. For example, six months after the shock, imports contribute around 17 per cent of the total forecast variance of Australian production. This is a much larger contribution than the 7 per cent contribution over the same period in the full sample. Similarly, around 13 per cent of the forecast can be explained by imports after six months, compared to just 2 per cent in the full sample.

Table 6: Accumulated Impulse Responses, Sample Period 2002:9 - 2007:8

Period	LAFPP	LAUSPR	LAWP	LNSWPR
1	0	0	0	0
2	-0.07495	0.032589	-0.10157	0.084024
3	-0.16893	0.107177	-0.19883	0.169922
4	-0.25403	0.148379	-0.28993	0.218922
5	-0.3218	0.189691	-0.35276	0.264285
6	-0.3706	0.21729	-0.39674	0.295325
7	-0.40203	0.238843	-0.42073	0.319481
8	-0.41895	0.252665	-0.43035	0.33571
9	-0.42454	0.261433	-0.42851	0.34659
10	-0.42178	0.265738	-0.41895	0.352809
11	-0.41329	0.266942	-0.40433	0.355688
12	-0.40122	0.265829	-0.38698	0.356024

Table 7: Variance Decomposition of LAFPP, Sample Period 2002:9 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.217101	2.863815	97.13619	0	0	0	0
2	0.2394	18.56024	80.01484	0.833572	0.259442	0.19581	0.021743
3	0.246627	27.68784	68.94157	1.766093	0.308061	0.896218	0.151299
4	0.254287	32.25084	62.06378	2.284328	0.392225	2.234237	0.335285
5	0.26151	34.24625	57.63102	2.555819	0.47315	4.040801	0.470086
6	0.266805	34.76559	54.70497	2.675008	0.538688	6.097034	0.546933
7	0.270239	34.48223	52.78416	2.700068	0.585336	8.152028	0.579999
8	0.27223	33.84778	51.56022	2.673788	0.613699	9.98794	0.586184
9	0.273322	33.15262	50.81516	2.626332	0.627105	11.4721	0.579402
10	0.273908	32.55409	50.38568	2.576773	0.630064	12.56793	0.568849
11	0.274248	32.11124	50.15245	2.534897	0.626892	13.31062	0.559418
12	0.274484	31.82312	50.03332	2.504017	0.620938	13.77162	0.552958

8. Conclusions

This report examined the impacts of imports of pigmeat, classified within subheading 0203.29 of the Australian Customs Tariff, on domestic pigmeat prices. The findings from this analysis provide convincing evidence that pigmeat imports do have a substantial negative impact on domestic pig and pigmeat prices. The prices specified in the model are the national contract price for baconers and the Sydney wholesale price for bacon (see Section 3 of this report). The negative price responses hold true for the two sample periods examined, January 1995 to August 2007 and September 2002 to August 2007. The adverse impacts are more severe over the past five years, suggesting that the influence of imports on domestic prices has increased over time.

Granger and Sims causality tests were used to statistically test for the existence of causal relationships between pigmeat imports and the chosen variables in the study. Multi-directional feedback effects found among the variables indicated that Vector Autoregression was a suitable method to model the interrelationships.

Impulse response functions were used to track the responsiveness of domestic prices over time to a 1 per cent increase in total pigmeat imports. The results from both sample periods display similar significant downward movements in prices. When the full sample set of data

were examined, the accumulated impacts on domestic prices were shown to be considerable. In response to a 1 per cent increase in the quantity of imported pigmeat, the contract price of pigs is estimated to fall by around 0.25 per cent after one year and a little over 0.30 per cent at the end of two years. The magnitudes of the price changes are even greater when only the most recent five years data are considered. Around nine months after the shock is implemented, both the contract price and wholesale price are approximately 0.42 per cent below their initial values.

Variance decomposition techniques were used to examine the importance of the interactions among the variables. The variance decompositions of the contract price and the wholesale price imply that the explanatory relationship of pigmeat imports on domestic prices is strong. The influence of pigmeat imports on domestic pigmeat prices appears even more dominant over the most recent sample period, reaffirming the results from the impulse responses.

A secondary aim of the report was to determine if the same classification of pigmeat imports cause a decline in domestic pigmeat production. The results from the VAR provide no indication that this is the case. Contrary to what might theoretically be expected, the production response to increased pigmeat imports is positive. This is not inconsistent with previous results (e.g. Griffith 1998).

Two econometric studies were commissioned by the Productivity Commission in the 1998 inquiry into safeguard action against pigmeat imports. The report by Griffith (1998) indicated there was a strong possibility that imports affect domestic prices. The IRIC/Muresk (1998) report did not find any evidence of a link from import volumes to prices. In refereeing the two reports, Dr Brett Inder highlighted a number of reasons for ambiguities in the results. An important reason listed was the lack of adequate data. Although over five years data on pigmeat imports were available for the analyses, the domestic market share of imports over the data period was very small, making their impact hard to measure. Hence, the Productivity Commission's 1998 affirmative finding for safeguards action against imports did not rely on the econometric evidence presented from the commissioned studies. Ronan (1999) concluded that this suggests longer data sets may be necessary to 'explain real market behaviour with credibility'. Based on the Productivity Commission's recommendations, the Federal Government opted for measures to facilitate industry adjustment and further develop export market access in preference to the imposition of tariffs or quotas.

The results of this study are based on a much longer sample period than the data sets used in the 1998 studies. In addition, import market share has increased markedly in recent years in comparison to the market share occupied by imports in the earlier period estimations. It seems reasonable to conclude that, initially, any impacts on the domestic market were negligible because import volumes were small and irregular in supply. However, as import volumes have continued to grow, so too have the impacts on the domestic market.

In summary, this report finds evidence of a significant causal relationship between the level of imports of pigmeat into Australia and the domestic contract bacon price received by pig producers. The report also finds evidence of a significant causal relationship between the level of imports of pigmeat into Australia and the domestic wholesale bacon price. Increased levels of pigmeat imports are shown to have a substantial negative impact on both domestic prices. The results indicate that the relationships between imports and domestic prices have intensified over time.

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Appendix

Table A1: Summary Statistics, Sample Period 1995:1 - 2007:8

	AFPP	AUSPR	AWP	IMPO	EXR	NSWPR
Mean	227.59	31236.16	325.67	5338.64	0.68	9477.64
Median	229.22	30942.00	333.25	4635.95	0.71	9374.50
Maximum	291.67	39721.00	433.75	20115.37	0.86	13346.00
Minimum	160.72	24636.00	220.00	230.83	0.49	6250.00
Std. Dev.	25.32	3098.25	47.85	4473.47	0.10	1751.42
Skewness	-0.04	0.21	-0.08	0.97	-0.39	0.34
Kurtosis	3.01	2.69	2.37	3.48	1.92	2.18
Observations	152.00	152.00	152.00	152.00	152.00	152.00

Table A2: VAR Lag Order Selection Criteria

Endogenous variables: LIMPO LAFPP LAUSPR LAWP LEXR LNSWPR
Exogenous variables: C
Date: 11/10/07 Time: 08:04
Sample: 1995M01 2007M08
Included observations: 144

Lag	LogL	LR	FPE	AIC	SC	HQ
0	559.2177	NA	1.85E-11	-7.68358	-7.559837	-7.633298
1	1161.402	1145.823	7.13E-15	-15.54725	-14.68106*	-15.19528
2	1238.644	140.5371	4.03E-15	-16.12006	-14.51141	-15.46639
3	1301.136	108.4927	2.81e-15*	-16.48800*	-14.1369	-15.53264*
4	1332.383	51.64542*	3.04E-15	-16.42199	-13.32844	-15.16495
5	1358.515	41.01124	3.55E-15	-16.28492	-12.44892	-14.72619
6	1386.258	41.22948	4.10E-15	-16.17025	-11.59178	-14.30982
7	1411.538	35.46195	4.97E-15	-16.02135	-10.70044	-13.85924
8	1446.706	46.40346	5.32E-15	-16.00981	-9.946444	-13.546

* indicates lag order selected by the criterion

Table A3: Augmented Dickey-Fuller Unit Root Test Results

Variable	Optimum Lag Length	t-Statistic	Prob.*	Critical Value 5% level	Decision
LAFPP	2	-3.48877	0.0096	-2.88085	no unit root
LAWP	0	-2.51875	0.113	-2.88059	unit root
LAUSPR	12	-1.16394	0.6889	-2.88228	unit root
LEXR	0	-0.90094	0.7858	-2.88059	unit root
LIMPO	2	-1.55641	0.5023	-2.88085	unit root
LNSWPR	13	-1.36346	0.5985	-2.88243	unit root

*MacKinnon (1996) one-sided p-values.

Table A4: VAR Stability Condition Check

Root	Modulus
0.965435 - 0.021146i	0.965666
0.965435 + 0.021146i	0.965666
0.886705	0.886705
0.536676	0.536676
0.372894	0.372894
0.055979	0.055979

Table A5: Vector Autoregression Estimates, Sample Period 1995:1 - 2007:8

	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR	TREND	SEAS(12)
LIMPO(-1)	0.579802	-0.018905	0.022814	-0.007539	-0.007489	0.017874	8.57E-13	0.036787
	[8.63049]	[-2.58585]	[1.80560]	[-0.73152]	[-1.45856]	[0.89830]	[0.77036]	[0.71450]
LAFPP(-1)	0.849493	0.840488	-0.345109	0.513741	0.192708	0.056829	6.94E-11	0.459806
	[1.16443]	[10.5864]	[-2.51520]	[4.59060]	[3.45625]	[0.26301]	[5.74371]	[0.82241]
LAUSPR(-1)	-0.577795	0.056638	-0.147674	0.029676	0.13733	-0.53672	-2.35E-11	0.471022
	[-0.83535]	[0.75243]	[-1.13518]	[0.27969]	[2.59784]	[-2.61988]	[-2.05346]	[0.88858]
LAWP(-1)	-0.28825	0.120686	0.013459	0.474517	-0.102871	-0.12279	-6.06E-11	0.186308
	[-0.47065]	[1.81069]	[0.11684]	[5.05065]	[-2.19770]	[-0.67691]	[-5.97832]	[0.39693]
LEXR(-1)	-0.474265	-0.022586	-0.095317	-0.040381	0.978303	-0.28182	2.75E-11	-0.16976
	[-1.84591]	[-0.80776]	[-1.97253]	[-1.02457]	[49.8212]	[-3.70344]	[6.45256]	[-0.86214]
LNSWPR(-1)	-0.150028	0.00814	0.190305	0.001699	-0.049397	0.716542	4.88E-11	-0.53067
	[-0.38706]	[0.19298]	[2.61046]	[0.02857]	[-1.66745]	[6.24142]	[7.59765]	[-1.78643]
@TREND	0.010521	0.000233	0.000769	0.000744	0.000232	0.001068	1	-0.00107
	[5.82658]	[1.18499]	[2.26484]	[2.68655]	[1.67993]	[1.99698]	[3.3e+13]	[-0.77578]
@SEAS(12)	-0.124888	-0.017512	-0.101915	-0.021232	-0.002374	-0.19676	-2.64E-12	-0.10324
	[-1.14642]	[-1.47713]	[-4.97421]	[-1.27054]	[-0.28514]	[-6.09801]	[-1.46345]	[-1.23655]
C	6.864407	-0.364097	11.65548	-0.080837	-1.384482	8.22452	1	-3.78749
	[1.13364]	[-0.55253]	[10.2345]	[-0.08703]	[-2.99167]	[4.58590]	[1.0e+10]	[-0.81618]
R-squared	0.906435	0.893569	0.570563	0.880116	0.969031	0.698414	1	0.07618
Adj. R-squared	0.901163	0.887573	0.546369	0.873362	0.967286	0.681423	1	0.024134
Sum sq. resids	17.37502	0.205777	0.614609	0.408868	0.10149	1.524211	4.76E-21	10.20485
S.E. equation	0.349799	0.038067	0.065789	0.05366	0.026734	0.103604	5.79E-12	0.268077
F-statistic	171.9569	149.0252	23.58314	130.3093	555.4013	41.10551	1.07E+27	1.463694
Log likelihood	-51.01012	283.9075	201.2959	232.0694	337.2738	132.7234	3697.424	-10.8312
Akaike AIC	0.794836	-3.641159	-2.546966	-2.954562	-4.347997	-1.63872	-48.8533	0.262665
Schwarz SC	0.974674	-3.461321	-2.367128	-2.774724	-4.168159	-1.45888	-48.6735	0.442503

t-statistics in [ ]

Table A6: Impulse Responses, Sample Period 1995:1 - 2007:8

Period	LAFPP	LAWP	LNSWPR	LAUSPR
1	0	0	0	0
2	-0.01891	-0.00754	0.017874	0.022814
3	-0.0268	-0.01743	0.00565	0.016648
4	-0.02931	-0.02355	0.002716	0.014761
5	-0.02919	-0.02634	0.002129	0.012979
6	-0.02779	-0.02682	0.003248	0.011922
7	-0.02578	-0.02589	0.004948	0.011222
8	-0.02352	-0.02419	0.006692	0.010687
9	-0.0212	-0.02212	0.008237	0.010204
10	-0.0189	-0.0199	0.00951	0.009727
11	-0.01671	-0.01767	0.010518	0.009243
12	-0.01463	-0.0155	0.011296	0.008753
13	-0.01269	-0.01345	0.011885	0.008265
14	-0.01089	-0.01152	0.012324	0.007785
15	-0.00923	-0.00974	0.012645	0.007321
16	-0.00771	-0.00809	0.012873	0.006875
17	-0.00631	-0.00657	0.013028	0.006451
18	-0.00503	-0.00519	0.013124	0.006051
19	-0.00387	-0.00392	0.013173	0.005674
20	-0.00282	-0.00277	0.013183	0.005322
21	-0.00186	-0.00173	0.013161	0.004992
22	-0.001	-0.00079	0.013112	0.004684
23	-0.00021	6.64E-05	0.01304	0.004397
24	0.00049	0.000834	0.012949	0.004129

Table A7: Variance Decomposition of LAWP, Sample Period 1995:1 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.038067	1.318742	30.42862	0.656593	67.59604	0	0
2	0.052762	2.00642	43.49462	0.683915	53.11129	0.024978	0.034821
3	0.06315	3.349827	51.01674	0.876762	43.72829	0.094182	0.029076
4	0.071034	4.790561	55.01873	1.120574	37.65632	0.203986	0.05269
5	0.077176	6.083096	57.09682	1.364327	33.61171	0.352093	0.111583
6	0.082029	7.135754	58.15877	1.579749	30.81732	0.53645	0.195214
7	0.0859	7.950259	58.67911	1.756582	28.82207	0.755588	0.291696
8	0.089012	8.561351	58.9026	1.894222	27.35732	1.008131	0.391673
9	0.091528	9.009501	58.95674	1.996521	26.25707	1.292547	0.489037
10	0.093574	9.330831	58.90928	2.068914	25.41454	1.607019	0.580296
11	0.095247	9.554712	58.79722	2.117008	24.75848	1.949424	0.663765
12	0.096624	9.704151	58.64145	2.145953	24.23972	2.317344	0.738894
13	0.097765	9.796927	58.45425	2.160218	23.82339	2.708119	0.805793
14	0.098717	9.846758	58.2433	2.163547	23.48419	3.118902	0.864925
15	0.09952	9.864252	58.0137	2.159012	23.2034	3.54673	0.916914
16	0.100203	9.857653	57.76918	2.149089	22.96704	3.988587	0.962439
17	0.100793	9.833393	57.51266	2.135745	22.76452	4.441468	1.00217
18	0.101307	9.796507	57.2466	2.120521	22.58777	4.902435	1.036738
19	0.101762	9.750938	56.97316	2.104603	22.43066	5.368667	1.066723
20	0.102171	9.699769	56.6943	2.088886	22.28848	5.837499	1.092649
21	0.102542	9.645401	56.41184	2.074028	22.15766	6.306452	1.114985
22	0.102885	9.58969	56.12741	2.060498	22.03547	6.773258	1.134151
23	0.103206	9.534054	55.84253	2.048608	21.91988	7.235874	1.150518
24	0.103508	9.479558	55.55857	2.03855	21.80936	7.692485	1.164419

Table A8: Variance Decomposition of LNSWPR, Sample Period 1995:1 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.065789	0.397808	2.312806	62.00637	0.263208	1.681861	33.33794
2	0.074267	2.076705	2.316392	46.00788	0.407278	3.053585	29.82405
3	0.076575	2.05287	2.263892	42.48149	0.636062	4.605298	31.51774
4	0.078002	2.00915	2.194457	40.6568	0.774475	6.095648	31.75347
5	0.078997	1.96762	2.146454	39.51489	0.810869	7.55372	31.66538
6	0.079768	1.938031	2.112059	38.66502	0.807443	8.960646	31.41113
7	0.080403	1.919117	2.08644	37.96241	0.794216	10.30512	31.07813
8	0.080944	1.910842	2.067634	37.34587	0.781322	11.58099	30.70695
9	0.081413	1.913301	2.055095	36.7871	0.770821	12.78623	30.31957
10	0.081822	1.926009	2.048756	36.27165	0.76238	13.92146	29.92858
11	0.08218	1.947907	2.04861	35.79138	0.755269	14.98876	29.54148
12	0.082493	1.97763	2.054553	35.34125	0.748899	15.99106	29.16281
13	0.082766	2.013759	2.066351	34.91783	0.742895	16.93166	28.79532
14	0.083006	2.054971	2.083652	34.51862	0.737045	17.81398	28.44059
15	0.083215	2.100103	2.106015	34.14169	0.731246	18.64146	28.09949
16	0.083399	2.148166	2.132943	33.78542	0.725462	19.41744	27.77239
17	0.083559	2.198336	2.16391	33.44845	0.719689	20.14514	27.45935
18	0.0837	2.249931	2.198383	33.12959	0.713942	20.8276	27.16021
19	0.083823	2.302388	2.235841	32.82776	0.708245	21.46774	26.87468
20	0.083932	2.355247	2.275782	32.54197	0.702622	22.06829	26.60239
21	0.084028	2.408127	2.317739	32.27133	0.697097	22.63183	26.34289
22	0.084112	2.460717	2.361278	32.01498	0.69169	23.16076	26.09573
23	0.084186	2.512762	2.406002	31.77214	0.686418	23.65737	25.86042
24	0.084252	2.564053	2.451554	31.54207	0.681293	24.12376	25.63648

Table A9: Variance Decomposition of LAUSPR, Sample Period 1995:1 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.05366	1.444854	3.692005	94.86314	0	0	0
2	0.06673	5.079229	7.48756	74.57766	0.002516	0.435791	0.438761
3	0.075888	5.814493	9.788398	70.1812	0.162695	0.888418	1.814821
4	0.083174	6.380391	11.18735	67.63907	0.40692	1.257056	2.114701
5	0.089093	6.745981	12.19898	65.97021	0.572325	1.575616	2.195928
6	0.093915	7.01792	12.97616	64.7496	0.67112	1.850858	2.196438
7	0.097845	7.234933	13.59276	63.79339	0.728661	2.089418	2.173919
8	0.10105	7.416682	14.09048	63.013	0.763024	2.296721	2.147341
9	0.103669	7.572676	14.49689	62.36117	0.784377	2.477499	2.122797
10	0.105815	7.708015	14.83168	61.80952	0.798211	2.635787	2.101755
11	0.107581	7.825837	15.10946	61.33903	0.807518	2.774979	2.084142
12	0.109041	7.928419	15.34136	60.93573	0.813981	2.8979	2.069453
13	0.110256	8.017635	15.53596	60.58877	0.818582	3.006895	2.057144
14	0.111276	8.095131	15.69998	60.2894	0.821919	3.103908	2.046745
15	0.112139	8.162382	15.83875	60.03044	0.824371	3.190562	2.037882
16	0.112878	8.220711	15.95652	59.8059	0.826184	3.268215	2.030266
17	0.113518	8.271294	16.05674	59.61078	0.827527	3.338009	2.023672
18	0.11408	8.315168	16.14222	59.44084	0.828517	3.400914	2.017927
19	0.11458	8.353242	16.21528	59.29251	0.829238	3.457754	2.012895
20	0.115031	8.386306	16.27782	59.16278	0.829752	3.509237	2.008469
21	0.115443	8.415044	16.33145	59.04907	0.830106	3.55597	2.00456
22	0.115826	8.440047	16.37749	58.9492	0.830336	3.598482	2.001098
23	0.116184	8.461823	16.41706	58.8613	0.830468	3.63723	1.998023
24	0.116524	8.480811	16.45111	58.78378	0.830524	3.672612	1.995285

Table A10: Impulse Responses, Sample Period 2002:9 - 2007:8

Period	LAFPP	LAUSPR	LAWP	LNSWPR
1	0	0	0	0
2	-0.07495	0.032589	-0.10157	0.084024
3	-0.09398	0.074588	-0.09726	0.085898
4	-0.0851	0.041202	-0.0911	0.049
5	-0.06777	0.041312	-0.06283	0.045363
6	-0.0488	0.027599	-0.04398	0.03104
7	-0.03143	0.021553	-0.02399	0.024156
8	-0.01692	0.013822	-0.00962	0.016229
9	-0.00559	0.008769	0.001842	0.01088
10	0.002758	0.004305	0.009555	0.006219
11	0.00849	0.001203	0.014621	0.002878
12	0.012065	-0.00111	0.017346	0.000336
13	0.013935	-0.00261	0.018378	-0.0014
14	0.014515	-0.00354	0.018133	-0.00254
15	0.014167	-0.00398	0.01703	-0.00319
16	0.013192	-0.00409	0.01538	-0.00347
17	0.011831	-0.00395	0.013441	-0.00349
18	0.010275	-0.00365	0.0114	-0.00332
19	0.008664	-0.00325	0.009395	-0.00303
20	0.007099	-0.0028	0.007519	-0.00267
21	0.005647	-0.00235	0.00583	-0.00228
22	0.004348	-0.00191	0.004358	-0.00189
23	0.003224	-0.00151	0.003114	-0.00153
24	0.002278	-0.00115	0.00209	-0.00119

Table A11: Variance Decomposition of LAWP, Sample Period 2002:9 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.066757	2.640034	16.47337	1.375875	79.51072	0	0
2	0.075937	19.01483	29.33139	1.334711	48.66055	1.577691	0.052346
3	0.079203	24.66216	31.31928	3.232331	36.92172	3.001952	0.10104
4	0.081313	28.41645	30.19872	3.169252	32.32793	4.846195	0.324898
5	0.082331	29.44323	28.7121	3.373848	30.0016	7.173453	0.403327
6	0.082923	29.48921	27.51295	3.357094	28.78348	9.484765	0.457691
7	0.083212	28.94351	26.74677	3.322348	27.96985	11.61043	0.469694
8	0.08337	28.26944	26.42097	3.253343	27.32211	13.33824	0.466837
9	0.08346	27.66876	26.40796	3.182883	26.74344	14.62546	0.457475
10	0.083526	27.2296	26.58737	3.12145	26.22061	15.4962	0.448531
11	0.083583	26.95863	26.84835	3.073652	25.7627	16.03362	0.44252
12	0.083636	26.8234	27.11974	3.040138	25.37942	16.32911	0.439713

Table A12: Variance Decomposition of LAUSPR, Sample Period 2002:9 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.032627	9.617774	1.098173	89.28405	0	0	0
2	0.049359	10.39625	10.02337	73.84463	0.432172	0.147442	0.359284
3	0.060614	13.88396	11.95449	67.90186	0.400769	0.382265	0.610865
4	0.067508	15.20444	13.46086	64.97006	0.404178	0.363033	0.604381
5	0.07144	16.31478	13.97075	63.41254	0.403954	0.368476	0.657738
6	0.07365	16.81796	14.18244	62.61637	0.410513	0.442427	0.670319
7	0.074986	17.09573	14.20808	62.20919	0.415452	0.551929	0.684502
8	0.075939	17.19416	14.18083	61.99512	0.42018	0.691053	0.689438
9	0.076743	17.21493	14.15014	61.86689	0.423328	0.830387	0.691893
10	0.077478	17.19955	14.13587	61.77161	0.425357	0.958426	0.692063
11	0.078154	17.17641	14.14154	61.68811	0.426377	1.064886	0.691449
12	0.078753	17.15755	14.16167	61.61027	0.426745	1.147844	0.690588

Table A13: Variance Decomposition of LNSWPR, Sample Period 2002:9 - 2007:8

Period	S.E.	LIMPO	LAFPP	LAUSPR	LAWP	LEXR	LNSWPR
1	0.051843	5.037346	0.354458	72.774	0.107866	0.146787	21.57955
2	0.067635	7.617679	5.72017	66.38689	0.093027	0.889923	18.7799
3	0.077794	10.31892	7.336183	62.60165	0.091748	1.119423	17.92439
4	0.083296	11.41789	8.486966	60.76308	0.101797	1.096673	17.34301
5	0.086636	12.1977	8.951347	59.78617	0.10513	1.078724	17.09965
6	0.088569	12.5775	9.177449	59.29027	0.110119	1.082746	16.95599
7	0.089935	12.79043	9.249456	59.03792	0.1135	1.109314	16.89078
8	0.091049	12.8829	9.263212	58.91187	0.116403	1.15551	16.85597
9	0.092062	12.91787	9.256575	58.84461	0.118377	1.208658	16.83817
10	0.092993	12.92335	9.249711	58.80212	0.119737	1.261875	16.82645
11	0.093824	12.91831	9.249494	58.76872	0.120564	1.308963	16.81711
12	0.094534	12.91167	9.256171	58.73846	0.121035	1.347536	16.80849

GLOSSARY OF TERMS

Contemporaneous correlation: the error terms in the equations are correlated at the same point in time

Error term: the error term is a random variable that captures the behaviour of all the factors other than the specified variables in the model

Impulse response function: a graph depicting movements in the endogenous variables over time after a one-time shock to the system

Innovation: error, the difference between the estimated and true values

Moving average: the mean of the previous *n* data points, used to smooth out short-term fluctuations

Ordinary least squares regression: a linear regression method that estimates unknown values by minimizing the sum of squared errors

Shock: disturbance, in this study defined as a 1 per cent increase in imports

Level of significance: the probability of a Type 1 error in hypothesis testing (rejection of the null hypothesis when it is true)

Standard deviation: a measure of the spread of values

Standard error: the standard deviation of the error

Stationarity: the mean and variance of the data series is constant over time

Unit root process: a highly persistent time series process where the current value equals last period’s value plus a disturbance term

Variance decomposition: the proportion of the movements in a variable due to its own shocks, relative to shocks to other variables

Vector autoregression model: an econometric model used to capture the relationship among time series. Each variable is treated as endogenous and is specified as a function of its own lagged values and the lagged values of the other variables in the model