An Empirical Investigation of the Impact of Imported Canadian Swine on U.S. Hog Prices

Colin A. Carter
University of California

Thomas J. Prusa
Rutgers University

February 16, 2005

Executive Summary

Previous work by Alton, Carter, Green and Pick (1990) and McDaniel and Balistreri (2002) indicate that the traditional elasticity approach likely overstates the actual prices impact of imports, especially for agricultural commodities like live swine. Particularly apropos is the work of McDaniel and Balistreri who show that in many cases the conventionally accepted elasticity is five to ten times larger than it would be if it were appropriately measured.

In this report we eschew the traditional elasticity approach embraced by the domestic industry in their attempt to "guesstimate" the price impact of imported live swine. Instead, we precisely quantify the actual market impact of imports during the POI. Our results confirm McDaniel and Balistreri's finding that the traditional elasticity approach dramatically overstates true price effects.

Our approach is rooted in existing academic work by Parcell, Mintert, and Plain (2004) and Bullock (2003). Using the lessons conveyed by their work, we develop a model that does an exceptional job explaining the determinants of hog prices, explaining over 97% of the price variation of the POI. Our model allows us to quantify the roles played by demand-side factors (e.g., pork demand, events in the greater meat protein market), supply-side factors (e.g., corn and soybean meal prices), packer costs and capacity, seasonal factors, and of course imports of Canadian swine.

Importantly, we distinguish the impact of imported baby pigs from that of imported slaughter hogs. Slaughter hogs enter the US market weighing about 265 pound. By contrast, baby pigs enter the US market weighing somewhere between 10 pounds

(isoweans) and 50 pounds (feeder pigs). These baby pigs are then brought to market weight by US hog farmers.

We find that neither slaughter hog nor baby pig imports have had an economically or statistically significant impact on the domestic hog price. That is, even though the overall model is highly precise, the impact of imports has been so small that we can not be sure that the impact is not zero. Statistically speaking, the measured impact of imports is zero. We perform a variety of robustness tests and the benchmark results are confirmed over and over again.

We then calculate the direct and indirect impact of imports on US hog prices. The direct impact of imports of Canadian swine is simply the measured price impact that such imports have had the domestic price of hogs. Over the POI we find the direct impact of imports of Canadian swine is about 4-6 cents per cwt. We also allow for imports to have an indirect impact on hog prices via their impact on congestion at packing houses. Including the indirect effect we find the total impact of imports of Canadian swine on the domestic price increases to about 16 cents per cwt.

Given the miniscule price effects the empirical evidence is overwhelming – the increase in imports of live swine from Canada over the POI has lowered the hog price by an economically insignificant amount. The empirical results imply that the importation of Canadian live swine has had no material impact on US hog prices.

1. Introduction

One of the more important and most frequent issues policymakers tackle is whether a particular market development has had or will have an impact on domestic prices and, if so, how large a price impact. For instance, how much will oil prices fall when Iraqi oil output is increased? How much will US corn prices fall when the EU restricts imports of genetically modified US corn? How much will coffee prices rise when there is a frost in Brazil?

In all of these examples policymakers must try to ascertain the price response to a change in the quantity supplied. Or, said in the language of economics, policymakers must determine the supply "price elasticity."[1] The simplest and quickest approach involves using Armington elasticities which allows an immediate prediction about the price response. For instance, suppose a rebuilt Iraq will increase the world supply of crude oil by 1.5% and suppose conventional wisdom is that the supply price elasticity is, say, -2. A conventional elasticity approach would lead an economist to conjecture that that a rebuilt Iraq will result in oil prices falling by 3 percent.

While this prediction seemingly makes sense, whether it realistically describes market realities depends crucially on the answers to two questions: (1) is the Armington approach appropriate for the question at hand, and (2) is the elasticity estimate correct?

With respect to the first question, Alton, Carter, Green and Pick (1990) demonstrate that with respect to agricultural markets, the answer is likely "no."[2] Using

---

[1] Economists often use the terms "price elasticity" and "price flexibility" interchangeably.
[2] Julian M. Alston; Colin A. Carter; Richard Green; Daniel Pick, "Whither Armington Trade Models?" *American Journal of Agricultural Economics*, Vol. 72, No. 2 (May, 1990), 455-467.

parametric and nonparametric techniques they reject the validity of the assumptions underlying the Armington approach. This result has important implications for international trade modeling and policymaking as it implies that simply quoting a price elasticity without confirming the appropriateness of the approach for the specific market will result in misleading conclusions.

With respect to the second question, McDaniel and Balistreri (2002) point out a number of serious caveats with the Armington approach. Specifically, they show that in many cases the conventionally accepted elasticity is five to ten times larger than it would be if it were appropriately measured![3] McDaniel and Balistreri's message is that economists (and policymakers) must be very cautious when calculating price impacts using the traditional elasticity approach:

> "There is no question that measurement of Armington elasticities is of fundamental importance in determining the response of trade models to policy experiments. There is equally little doubt that measurement of these elasticities is very difficult. *The estimates from the literature provide little guidance on the correct point estimate to apply to a given commodity*" (emphasis added, McDaniel and Balistreri, 2002, p. 12).

These two studies are a powerful indictment of using traditional elasticity calculations to make policy decisions. The traditional elasticity approach does have its virtues – it is quick (just quote an off-the-shelf elasticity) and easy (just multiply two numbers together). Unfortunately, unless one has verified the applicability to the particular market and has carefully measured the elasticity the entire exercise is meaningless.

---

[3] Christine A. McDaniel and Edward J. Balistreri, "A Discussion on Armington Trade Substitution Elasticities" U.S. International Trade Commission Office of Economics Working Paper No. 2002-01-A, January 2002.

McDaniel and Balistreri's critique is particularly relevant for the current proceedings. McDaniel and Balistreri's remark – that the price elasticity can be difficult to measure is especially in an industry with the price cycles like the hog industry. Simply looking at the percentage change in price for a given change in supply is likely to dramatically misrepresent the actual elasticity. Moreover, the elasticity value is particularly crucial in the present case as the presumption is that in commodity markets (including agricultural products such as live swine) even modest changes in supply can have a large impact on product pricing.

For instance, if one were willing to assume a sufficiently large price elasticity, even a miniscule increase total supply (e.g., due to an increase in Canadian supply) would have a significant price impact. Assuming that imported Canadian swine in fact results in an increase in the supply of North American swine[4] and assuming a price elasticity of, say, four, then one might argue that a one percent increase in swine imports has lowered hog prices by four percent. If both assumptions were true, this would be bold statement regarding the price impact of imported swine. Yet, there are serious reasons for questioning whether such a bold statement reflects market realities. If the critiques of Alton et al. (1990) and McDaniel and Balistreri (2002) are correct, policy conclusions based on so-called "conventional" elasticity estimates will seriously over-state the true impact of imported Canadian swine. As it turns out, our empirical approach is a striking confirmation of the central conclusion of McDaniel and Balistreri assertion: the

[4] In fact, this assumption is demonstrably false. Two-thirds of the imports of live swine from Canada are baby pigs and hence would be finished in either the U.S. or Canada. It follows that the importation of the baby pig has no impact on total North American hog supply. Moreover, unless there are binding packer capacity constraints in Canada, the importation of Canadian slaughter hogs also involves no change in total supply. While shackle space might have been limited at times during the POI, we have seen no evidence that Canadian packers were regularly running full-out over the POI.

conventional elasticity approach indeed overstates the actual impact of imports by at least a factor of ten.

In this report we eschew the "quick and easy" elasticity approach. We do not "guesstimate" the impact, rather we measure the impact. We precisely quantify the actual market impact of imports during the POI. Our approach is not unconventional. To the contrary, our empirical approach is grounded in mainstream economics and econometrics. While our approach requires a lot more effort, the extra work pays serious dividends. Our results are much more relevant for the current proceedings as they are based on actual market data and trends observed during the POI.

We estimate a regression model of pricing for the US hog market and precisely measure the impact of imported live swine from Canada. Our model allows us to quantify the roles played by demand-side factors (e.g., pork demand, events in the greater meat protein market), supply-side factors (e.g., corn and soybean meal prices), packer costs and capacity, seasonal factors, and of course imports of Canadian swine. Overall, the model is remarkably successful in explaining hog prices, accounting for more than 97% of the hog price variation over the POI.

It should be emphasized that we distinguish the impact of imported baby pigs from that of imported slaughter hogs. This is an important point. Slaughter hogs enter the US market weighing about 265 pounds and are processed within days of crossing the border. By contrast, baby pigs enter the US market weighing somewhere between 10 pounds (isoweans) and 50 pounds (feeder pigs). These baby pigs are then brought to market weight by US hog farmers. Then 17 to 26 weeks after crossing the border the baby pigs are ready to be slaughtered. Because of the considerable timing lag involved with baby pigs one must distinguish between the two types of swine if the quantification exercise is to have any merit.

We find that neither slaughter hog nor baby pig imports have had an economically or statistically significant impact on the domestic hog prices. The term "statistical insignificance" means that the impact is so small that we are unable to say that the effect is not zero. That is, even though the overall model is highly precise, the impact of imports has been so small that we can not be sure that the impact is not zero. Statistically speaking, the measured impact of imports is zero.

We perform a variety of robustness tests and the benchmark results are confirmed over and over again. The empirical results imply that the importation of Canadian live swine has had no material impact on US hog prices. The model is comprehensive as it allows for imports to have both direct and indirect impacts on US hog prices. The direct impact of imports of Canadian swine is simply the measured price impact that such imports have had the domestic price of hogs. Over the POI we find the direct impact of imports of Canadian swine is about 4-6 cents per cwt. Said differently, the increase in imports of live swine from Canada over the POI has lowered the market price by about one-tenth of one percent. It is safe to say, therefore, that imports of hogs from Canada have not had an economically significant impact on the domestic price of hogs.

We also allow for imports to have an indirect impact on hog prices via their impact on congestion at packing houses (e.g., packers' limited shackle space).[5] Including the indirect effect we find the total impact of imports of Canadian swine on the domestic price increases to about 16 cents per cwt. Even with the additional 10 cent price effect, one must conclude that imports of live swine have not had a material impact on the US

[5] Shackle space is the packing industry's term for packer capacity.

price of hogs – even under this worst case scenario the increase in imports of live swine from Canada over the POI has lowered the hog price by far less than one percent.

We think it is important to note that the empirical approach we adopt is a logical extension of professionally recognized and vetted empirical models of the hog market developed by prominent agricultural economists.[6] The ability to use existing academic literature to develop our approach has a number of benefits. First, the wisdom, the collected experience, and "real world" knowledge of these hog experts is equivalent to several lifetimes of field study. Their knowledge base is simply something that can not be created within the time constraints of a trade case. We believe our quantification model does such a great job characterizing hog price determination precisely because we have drawn from pre-existing models developed by hog industry experts working at universities and extension offices around the country. We got the model right because agricultural economists got the model right.

Second, using existing models as a starting point our investigation serves as independent evidence that our empirical approach is reasonable. The agricultural academics and extension agents that developed our basic empirical approach had no vested interest in this case. And, because our basic empirical approach is based on this prior work there is no basis for any claim that our model was concocted with the intent of showing a particular result. Third, basing our approach on existing academic models

[6] Related papers included J. Bruce Bullock, "Performance Evaluation of the U.S. Hog Slaughter Industry," University of Missouri Department of Agricultural Economics Working Paper No. AEWP 2003-1 (May 2003) and Joe Parcell, James Mintert, and Ron Plain, "An Empirical Investigation of Live-Hog Demand," *Journal of Agricultural and Applied Economics*, 36.3 (December 2004), 773-87. Also related is In Seck Kim, *A monthly structural model of United States slaughter hog and pork markets: with emphasis on the biological production process* PhD dissertation University of Missouri-Columbia, 2004, 121 pages

should reassure the Commission that our approach is economically sensible and captures the reality of the hog market.

Despite this report's clear lineage, there are two important differences between our work and the existing models. First, none of the prior work included imports as a potential factor determining hog prices. If nothing else the omission of imports in the prior work suggests that imports are immaterial.[7] However, since a key question for the current proceedings involves the price impact of subject merchandise we explicitly account for imports from Canada.

Second, we control for a number of statistical and econometric concerns beyond what is done in the prior agricultural economics academic studies. As we will show, doing so marginally increases the impact of imported Canadian swine but the measured effect is still trivial.

In summary, a careful econometric analysis of the hog market makes it crystal clear that subject imports have had no material role in explaining the movements in the price of hogs. As such, it makes no sense and is inappropriate to impose dumping duties on foreign competitors.

2. Related studies and the empirical model

There are several important studies that influenced the empirical model we use in this report. Parcell, Mintert, and Plain (2004) develop a single equation model of price determination in the hog market. The develop a model of hog prices using monthly data

[7] It is difficult to believe that prominent academic agricultural economists would fail to account for the role of imports if they felt imports were relevant to understanding the market forces determining hog prices.

where they hypothesize hog prices are determined by (i) the number of hogs slaughtered, (ii) average dressed weight, (iii) packer capacity and costs, (iv) demand for meat protein products (e.g., beef, chicken), (v) existing cold storage inventory (i.e., the processed hogs already in inventory), and (vi) seasonality. Interestingly, they explicitly motivate their study by the essentially the same question before the Commission – namely they sought to quantify the "price flexibility" of supply. As mentioned above, however, they do not include any measure of import supply in their model.

Despite the fact that imports do not enter their model, three important lessons emerge from their study. First, and probably the most important finding from their study is that price flexibility (or price elasticity) as conventionally quoted is far too large. They note that Wohlgenant (1989) using data from the 1980s found that the price flexibility was -2.07.[8] They also note that Plain and Grimes (1989) speculated that the price flexibility changed to -5 during the Fall 1998.[9] Parcell, Mintert, and Plain find, however, that when properly measured the price flexibility is about 1/6th of previous estimates – only -0.33. For perspective, Parcell, Mintert, and Plain's estimate implies that 2.5% increase in market share (head basis) would translate into less than 1% change in hog prices![10]

<u>Lesson #1: Price flexibility is much, much lower than conventional wisdom suggests</u>.

[8] Wohlgenant, M.K., "Demand for farm output in a complete system of demand functions," American Journal of Agricultural Economics, 71(1989): 241-52.
[9] Plain, R. and G. Grimes, "Spring and summer farrowings pegged 7% lower," *National Hog Farmer*, April 1999. (www.keepmedia.com/pubs/nationalhogfarmer/1999/04/30/167349).
[10] Even this small impact is probably an overstatement as it assumes that the imported Canadian swine results in an increase in the supply of North American swine. As discussed in footnote 4, this is a dubious proposition.

Second, Parcell, Mintert, and Plain find that price flexibility associated with weight of the hog is far, far more important than head count. Specifically, they find that the price flexibility of increased weight is -3.12. In other words the main price effect must be attributed to the farmer putting the weight on the hog. Parcell, Mintert, and Plain make it clear that weight changes have a far larger impact than simply looking at changes in the number of head.[11]

Lesson #2: It is patently false to claim "a hog is a hog is a hog" when attempting to quantify the price impact of changes in supply.

In the context of the current case Parcell, Mintert, and Plain's study implies that to the extent imports of isoweans (about 44% of subject merchandise) and feeder pigs (about 23% of subject merchandise) have a price impact, one must be very careful in attributing the impact to Canada. Slaughter hogs weight 265 pounds but the typical isowean weighs only 10 pounds when it crosses the border and the typical feeder pig weighs about 50 pounds. Thus, over 96% of the isowean's ultimate slaughter weight and over 80% of the feeder pig's ultimate slaughter weight must be attributed to time spent living in the United States. So, in the case of, Parcell, Mintert, and Plain's study implies that price impact of isoweans is just -0.12 (-3.12 x 10/265) and of feeder pigs is just -0.59 (-3.12 x 50/265); taken together, the (weight average) price flexibility of imported pigs weighing less than 50 pounds is just -0.28. Said differently, saying that the elasticity of baby pigs is "-2 to -4" overstates their actual impact by a factor of 7 to 17.

[11] When discussing the issue of price changes over their sample period Parcell, Mintert, and Plain state "most of the increase can be attributed to heavier hogs" (p. 783).

Third, Parcell, Mintert, and Plain note that capacity constraints can have a big impact on hog prices. In 1997 they report that plant closures and operational changes reduced packing capacity by about 8 percent.[12] Their results highlight that reductions or additions to packer capacity can affect hog prices. For example, the Triumph Packing Plant (in St. Joseph, Missouri) is slated to open in mid-2005 and will add about 2 percent to domestic packing capacity. The results in Parcell, Mintert, and Plain suggest this will increase hog prices.[13]

Lesson #3: Packer capacity should be incorporated into the analysis

Our approach is also closely related to Bullock (2003). There are two important insights gained from Bullock's model. First, slaughter hog production is a biological production process that requires time. Producing a slaughter hog requires 10 months from sow breeding to slaughter. Once a baby pig has reached the isowean stage, 26 weeks are required before the pig reaches slaughter weight. From the feeder pig stage, 17 weeks are required before slaughter.

Lesson #4: To properly study the hog market one must properly account for the time it takes a hog to grow.

[12] Parcell, Mintert, and Plain report a series of event reduced hog processing capacity by 23,400 hogs per day (p. 775). In 1996 the average federally inspected hog slaughter was about 288,000 hogs per day.
[13] Using an cost of production approach Dhuyvetter, Kastens, and Riley (2005) estimate the Triumph Plant will have a greater impact on hog prices than Canadian imports have had. See Kevin Dhuyvetter, Terry Kastens, and John Riley, "What Impact will the New Triumph Food Pork Plant Have on the Flow of Pigs to Midwestern Plants?" presentation at 2005 Swine Profitability Conference. Available at http://www.agmanager.info/dhuyvetter/presentations/Swine%20Profitability%20Conference%20(Feb2005)%20(slides).pdf .

Bullock's next observation is that demand for hogs is a derived demand. That is, there is no inherent market value in the hog itself; the value is in the pork resulting from a hog. Hence, demand for hogs is derived from the underlying demand for pork. Packers can only pay for hogs what retailers are willing to pay them. Pork competes for sales in the greater protein market. Pork competes in the greater protein market with beef and chicken, and as seen in the following figure, pork has the smallest market share. Bullock therefore argues that hog prices depend on pork prices, and pork prices, in turn, depend on the overall demand for protein in the marketplace.

<< insert figure >>

A couple of comments on the role of pork prices. First, Bullock makes a persuasive argument that the direction of causality runs from pork prices to hog prices. Second, some formula contracts fall under the rubric "value based" which simply means the contract links hog prices directly to wholesale product prices (just as Bullock argues).[14] Third, other agricultural experts have also expressed Bullock's assertion. A Purdue University marketing study states the point particularly well:

> "The demand for market hogs is derived from the demand for pork. Having an idea of the demand schedule for pork, retailers deduct an amount sufficient to cover their costs and provide a profit and thus define a wholesale demand schedule for pork. Like retailers, packer-processors then deduct an amount sufficient to cover costs and provide a profit and thereby define the demand for market hogs. So, the demand for market hogs is derived downward from the demand for pork."[15]

[14] See James Mintert "Hog Pricing Essay" for a discussion of using pork cutout prices to determine hog prices (at http://www.agecon.ksu.edu/livestock/Livestock%20Update%20Newsletters/lvst799.pdf).
[15] Steve R. Meyer, Ronald L. Plain, Glenn Grimes, "How and Where is Price Established?" available at http://www.genome.iastate.edu/edu/PIH/51.html ..

Fourth, according to studies of the USDA Mandatory Reports, the most frequently reported sale (by a 2-1 margin) is under the marketing arrangement entitled "Swine or pork market formula" which means the price of the hog is tied to meat prices.[16]

Lesson #5: The "protein market" determines pork prices, which in turn are the primary determinant of hog prices.

Combining the insights of these papers we model the price in the hog market during week t as

$$P^{hog}_t = f(P^{pork}_t, \text{Slaughter Capacity}_t, M^{slght}_t, M^{baby}_{t-k}, \text{Grain Costs}, \text{Seasonality}_t) \quad (1)$$

where

P^{pork}_t	=	Pork cutout price, week t
Slaughter Capacity_t	=	Federally Inspected Barrow & Gilt slaughter during week t
M^{slght}_t	=	Imports of Slaughter weight hogs from Canada in week t (head)
M^{baby}_{t-k}	=	Imports of baby hogs from Canada in week t-k (head) (discussed further below)
Grain Costs	=	Average price of corn and soybean meal over the time the slaughter hog was being fed

[16] See Glenn Grimes, Ron Plain, and Steve Meyer, "U.S Hog Marketing Contract Study," University of Missouri Department of Agricultural Economics Working Paper No. AEWP 2004-07, January 2004. Available at http://agebb.missouri.edu/mkt/vertstud04.htm .

Seasonality$_t$ = Monthly dummies to capture seasonal movements in prices.

In words, we are modeling cash price of hogs as a function of the key factors identified by leading agricultural experts. Parcell, Mintert, and Plain's estimate their model using monthly prices; Bullock uses weekly prices. We follow Bullock's lead and estimate weekly hog prices for the 2002-2004 period which allows us to estimate our model using data entirely within the POI.

3. Data and Econometric Issues

The specific data sources are described in the appendix A, printed in appendix B, and are also submitted in electronic format (Excel). Four important comments regarding the data are in order. First, all the data used in the analysis is publicly available. The U.S. Department of Agriculture's *National Agricultural Statistics Service* and *Agricultural Marketing Service* provide remarkably detailed information for most livestock and grain series. Second, AMS/USDA also publishes a weekly data series on imports of live swine from Canada. The weekly series does not include information on weight of the swine, but it does break the shipments into feeder pigs (those weighing less than 50 pounds) and hogs ready for immediate slaughter. It does not distinguish isoweans and feeder pigs. As result, we are offer alternative specifications where we lag imports by 17 weeks (the appropriate length for a feeder pig) and by 26 weeks (the appropriate length for an isowean). Third, we wanted to control the impact that grain prices might have had on hog prices. The two most commonly used protein supplements in North America are corn and soybean meal.[17] Because the cost of these feeds accrues to the farmer over the lifetime of the hog we compute the average corn and soybean meal price over the eight months prior to the slaughter week. Fourth, the price of pork is determined by the USDA using their "cutout" procedure. The pork cutout represents the revenue that an animal generates for a packer. It is simply the sum of the value of its various meat cuts. The USDA calculates the percentage that each cut of meat (e.g., loin, ribs, etc.) comprises of the hog's weight and then computes the aggregate value of the various cuts of pork.[18]

We next turn to two econometric details. First, the price data is correlated over time. We account for the issue in all of our runs. We do so in two ways. We begin by estimating a first order autocorrelation adjusted model (AR1) using the standard Cochrane-Orcutt iterative method.[19] We also first differenced the data and estimated the model using the first-differenced data.

The second issue involves the potential endogeneity of the pork cutout price. Despite the voluminous evidence that causality runs from pork prices to hog prices, we wanted to dispel any notion that our results are biased by potential reverse causality. For both our AR1 adjusted and first difference estimates we also estimate using two-stage least squares. The two-stage least squares is a technique that allows us to explain (or "instrument") for the pork cutout price. In effect, our estimation proceeds in two stages: we model pork prices as a function of conditions in the overall protein market and then

---

[17] For evidence, see Shane Ellis, William Edwards, and John Lawrence, *Livestock Enterprise Budgets for Iowa — 2005* available on John Lawrence's web site at http://www.extension.iastate.edu/Publications/FM1815.pdf . Soybean meal is the product remaining after extracting most of the oil from whole soybeans.

[18] Shawn: does the value of byproducts enter the cutout value?

[19] The procedure is discussed in all standard econometric textbooks, such as Jeffrey M. Wooldridge *Introductory Econometrics* 2nd edition, South-Western, 2002 (Ch. 12) and James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Addison Wesley, 2002 (Ch. 13).

nest this fitted pork price into the hog price model. That is, using the two stage method in effect estimate

$P^{hog}_t = f(P^{pork}_t$, Slaughter Capacity$_t$, M^{slght}_t , M^{baby}_{t-k} , Grain Costs, Seasonality$_t$) (1)

$P^{pork}_t = f(P^{beef}_t, P^{chicken}_t$, Seasonality) , (2)

where

P^{beef}_t	=	Price of beef cutout price, week t
$P^{chicken}_t$	=	Price of chicken cutout price, week t .

4. Results

The regression results are reported in a series of tables included in appendix A. In Tables 1-4 we report the estimates using the AR1 correction. In Tables 5-8 we report the estimates using the first difference approach.

Let's begin by looking at the results in Tables 1-4. As seen, in all specifications the fit is quite good. R-squared – which describes the overall proportion of variance in the prices that can be explained by the model – is above 0.97 in all cases. To get a sense of how accurately we predict hog prices we plotted the hog price along with the model's prediction (or fitted value) for the two stage least square estimates (specification B-17 and B-26 are reported in Tables 3 and 4). As can see, for almost all months the two lines virtually overlap.

Figure 1 - Visual Evidence of Model Fit
AR(1), IV estimation, 17 week lag on baby pig imports

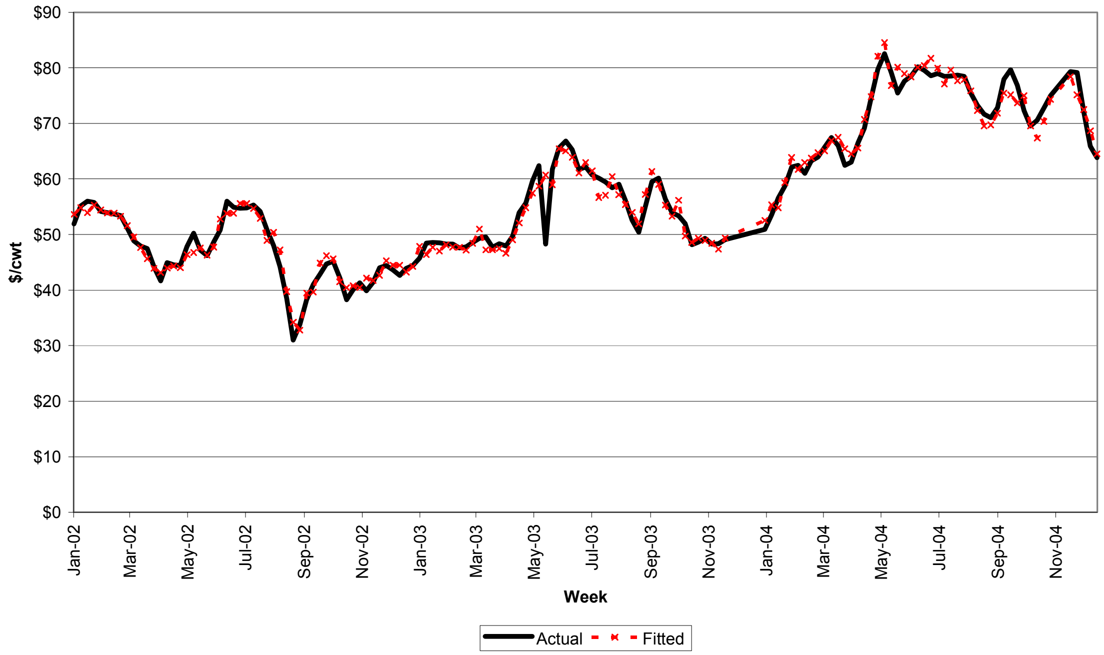
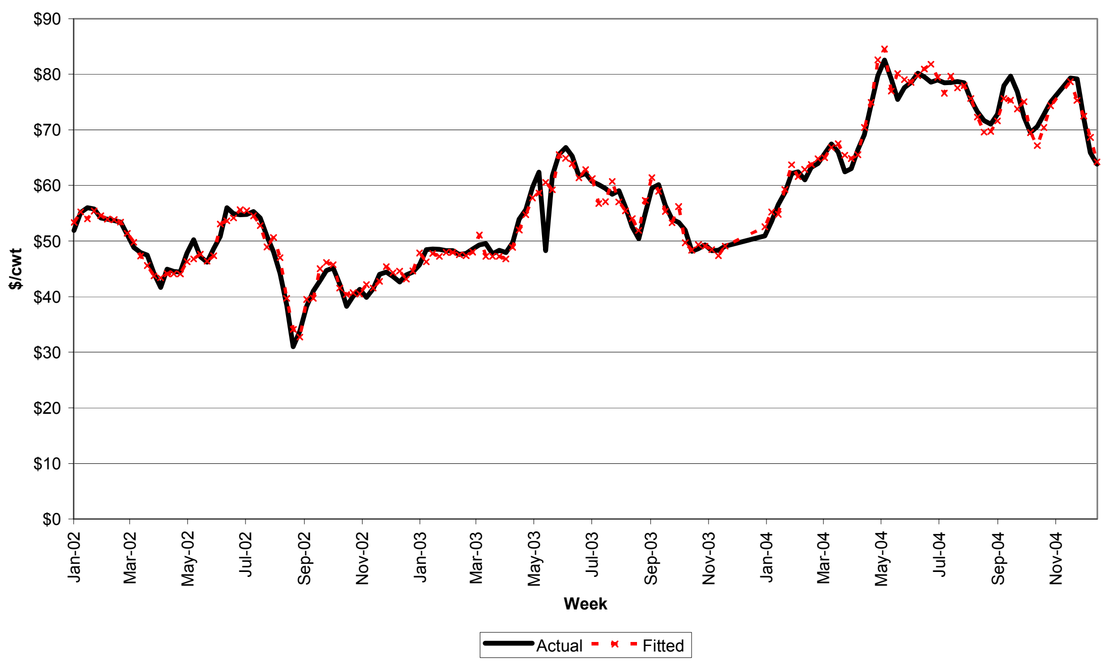


Figure 2 - Visual Evidence of Model Fit
AR(1), IV estimation, 26 week lag on baby pig imports



While complete regression results are in available the appendix, it is convenient to report the estimates for the four specifications side-by-side:

	Table 1	Table 2	Table 3	Table 4
Estimation Method	AR(1)	AR(1)	AR(1) – 2SLS	AR(1) – 2SLS
Lag Length on Baby Pigs	17	26	17	26
Imported Slaughter Hogs	-8.08E-08	-1.07E-08	-9.55E-06	-1.08E-05
Statistically Significant?	No	No	No	No
Imported Baby Pigs	-4.51E-06	-2.17E-05	-8.39E-06	-2.16E-05
Statistically Significant?	No	No	No	No

As one can see in no specification were either imports of baby pigs of slaughter hogs statistically significant. Statistical significance tells us the confidence we have that the effect of the variable is not zero. If a variable is statistically significant then its effect may be small, but we have confidence that there is some effect. If, on the other hand, a variable is statistically insignificant regardless of its size, its measured effect is uncertain enough that we can not tell that the effect is any different from zero. In the case of imported swine, the analysis indicates that their effect on market prices is effectively zero.

It is worth noting how similar the estimates are with and without the instrumental variable control. The estimated impact of imports increases slightly with the two stage least squares approach, but only marginally. This suggests that the academic literature that argued that the direction of causality runs from the overall protein market down to the hog market is correct.

The model also allows us to infer the price impact of the imported pigs. To do this we calculated the answer to the following "what if" question: what if live swine imports had stayed at their 2001 level during the entire 2002-04 period. Because of seasonality, we needed to be careful how we calculated this "what if" effect. For each week during the year we replaced the actual import volume with the corresponding week in 2001. That is, we imagined that imports during the first week of January 2002, 2003, and 2004 were exactly the same level as they were in the first week of January 2001. We did this for each week during the year.

The results are telling. Using a 17 month lag on baby pigs the direct impact of imported swine is about 4 cents per cwt. For the models using a 26 month lag on baby pigs the direct impact of imported swine is about 66 cents per cwt.[20] The average price of a market hog over the POI was about $57/cwt. In other words, the estimates imply that the increase in imports of live swine from Canada over the POI has lowered the market price by about one-tenth of one percent. It is safe to say, therefore, that imports of hogs from Canada have not had an economically significant impact on the domestic price of hogs.

In fact, the above estimates likely overstate the impact of imports from Canada. In all cases the price effect of imports of slaughter hog imports is very small – about one cent. Thus, most of the direct price impact of imported swine stems from the increase in imports of baby pigs. As discussed earlier, over 96% of the isowean's ultimate slaughter

[20] Estimates are derived from the AR1 estimates in Tables 1 and 2. The impact in the two stages estimates are 8 cents and 68 cents, respectively.

weight and over 80% of the feeder pig's ultimate slaughter weight must be attributed to time spent living in the United States. Unfortunately, the weekly import statistics do not allow us to directly measure this differential weight impact. But, given that Canadian baby pigs account for somewhere between 4% and 20% of the weight, we can adjust aforementioned price effects. Doing so, we conclude that the impact of imports is more likely in the 2-15 cent per cwt range.

The fact that imports of live swine are economically and statistically insignificant does not mean that there is something "wrong" with the model. To the contrary, the model fits exceptionally well. Pork cutout prices have a large statistically significant impact on hog prices. This is particularly relevant in the two stage least squares regressions where the result tells us that the trends in the greater overall protein market have a profound effect on hog prices. For instance, << fill-in stuff from preliminary documenting protein market events during the POI… Russia chicken ban, bse, etc.>>

The model also indicates that grain prices have little effect on hog prices. While somewhat surprising, in light of the movement in the industry toward formula pricing (of which less than 10% have a grain price component)[21] the result tells us that grain prices have a large impact on profits per hog, but only a small affect on hog prices.

Importantly, the model finds that packer capacity affects hog prices, confirming what Parcell, Mintert, and Plain (2004) and Bullock (2003) found. Over the POI we find packer capacity has had a statistically significant impact on hog prices. Yet, the capacity effect as a result of imports for Canada is not economically significant. To determine this we extended the "what if" calculation described above. That is, we supposed imports

[21] See Table 21 in Christian Boessen, John D. Lawrence, and Glenn Grimes, "Production and Marketing Characteristics of U.S. Pork Producers - 2003," Agricultural Economics Working Paper 2004-4. Available at http://www.econ.iastate.edu/faculty/lawrence/Final%20Draft%20Survey%20Article%202004.pdf .

from Canada remained at their 2001 levels. Then in each week we subtracted the slaughter hogs imported from Canada and also the baby pigs imported 17 to 26 weeks prior.[22] The estimates imply that capacity congestion induced by the imports from Canada resulted in hog price being about 10 cents/cwt lower than they would have otherwise been.

As discussed in Bullock (2003), the extent that packer capacity affects prices depends crucially on (i) the change in volume of hogs on the market and (ii) how close the industry is to maximum capacity. During the POI both factors combine to imply that the increase in imports of live swine from Canada have had a small impact via the capacity effect. Moreover, with the imminent addition of considerable additional packing capacity in St. Joseph, Missouri, it is improbable that the impact of imports via capacity will be any larger in the near future.

The first difference results reinforce all the lessons in the AR1 analysis.

<< to be finished tomorrow night >>

	Table 5	Table 6	Table 7	Table 8
Estimation Method	First Differences	First Differences	First Differences – 2SLS	First Differences – 2SLS
Lag Length on Baby Pigs	17	26	17	26
Imported Slaughter Hogs	-3.68E-05	-4.22E-05	-2.38E-06	-6.79E-06
Statistically	No	No	No	No

[22] As mentioned before, this means we are attributing all of the weight gained while these baby pigs are in the United States to Canada. Thus, our estimate is an overstatement of the capacity impact of imports from Canada.

Significant?				
Imported Baby Pigs	5.22E-07	-2.52E-05	-8.37E-06	-2.43E-05
Statistically Significant?	No	No	No	No

5. Implications

6. Conclusion

7. Appendix A – Estimation Results

LIST OF VARIABLES

VARIABLE	DESCRIPTION	SOURCE
P_CASH_HOG	Cash hog price	Three area lean value hogs, AMS report LM HG213
P_PORK_CUTOUT	Pork Cutout price	AMS carlot, report NW LS500
P_CORN_LAST33	Price of Corn, average over last 33 weeks ($/bushel)	Interior Iowa Daily Grain Prices, report NW GR110
P_SOY_LAST33	Price of Soymeal bean, average over last 33 weeks ($/ton)	Central Illinois Soybean Processor Report, report PA GR110
CAN_SLTR_BG	Canadian slaughter hog imports (weekly), head	Canadian Live Animal Imports in US by Destination - Slaughter Barrows/Gilts, report WA LS637
CAN_FD_L17	Canadian baby pig hog imports (weekly), head, lagged 17 weeks	Canadian Live Animal Imports in US by Destination - Feeder Pigs, report WA LS637
CAN_FD_L26	Canadian baby pig hog imports (weekly), head, lagged 26 weeks	Canadian Live Animal Imports in US by Destination - Feeder Pigs, report WA LS637
FIBGSLT	Federally Inspected Barrow & Gilt slaughter (weekly) 000 head	AMS weekly slaughter reports
FIBGSLT2	Federally Inspected Barrow & Gilt slaughter (weekly)- squared	AMS weekly slaughter reports
MDUM2-MDUM12	Monthly dummies	
BROILER_P	12 city broiler price ($/cwt)	Livestock, Meat & Wool Weekly Summary & Statistics
P_BF_CUTOUT_HS	Beef cutout price, heavy select 1-3, ($/cwt)	USDA Meat Price report, 1500 box beef composite cutout (AMS)
P_BF_CUTOUT_LS	Beef cutout price, light select 1-3, ($/cwt)	USDA Meat Price report, 1500 box beef composite cutout (AMS)

TABLE 1
SPECIFICATION A-17, 17 MONTH LAG FOR BABY PIGS
AR(1) ADJUSTMENT

Dependent Variable: P_CASH_HOG
Method: Least Squares
Sample(adjusted): 2 157
Included observations: 149
Excluded observations: 7 after adjusting endpoints
Convergence achieved after 14 iterations

Variable	Coeff	Std. Error	t-Statistic	Prob.
P_PORK_CUTOUT	1.005647	0.076159	13.20462	0.0000
P_CORN_LAST33	-2.876852	3.173107	-0.906636	0.3663
P_SOY_LAST33	0.055495	0.024562	2.259385	0.0255
CAN_SLTR_BG	-8.08E-08	3.52E-05	-0.002295	0.9982
CAN_FD_L17	-4.51E-06	2.17E-05	-0.207935	0.8356
FIBGSLT	-0.012283	0.005292	-2.321152	0.0218
FIBGSLT2	3.91E-06	1.71E-06	2.286065	0.0239
MDUM2	-0.190461	1.197772	-0.159012	0.8739
MDUM3	-0.347575	1.382378	-0.251432	0.8019
MDUM4	-0.769402	1.445492	-0.532277	0.5954
MDUM5	0.226620	1.511067	0.149974	0.8810
MDUM6	1.818096	1.530959	1.187554	0.2372
MDUM7	1.202225	1.486999	0.808491	0.4203
MDUM8	-0.036454	1.507391	-0.024184	0.9807
MDUM9	-1.711594	1.482060	-1.154875	0.2503
MDUM10	-3.045349	1.506489	-2.021487	0.0453
MDUM11	-3.220556	1.555542	-2.070376	0.0404
MDUM12	-2.238471	1.475357	-1.517240	0.1316
AR(1)	0.558507	0.078251	7.137416	0.0000

R-squared	0.975614	Mean dependent var	57.06960
Adjusted R-squared	0.972238	S.D. dependent var	12.31752
S.E. of regression	2.052347	Akaike info criterion	4.394467
Sum squared resid	547.5767	Schwarz criterion	4.777520
Log likelihood	-308.3878	Durbin-Watson stat	2.091184
Inverted AR Roots	.56		

TABLE 2
SPECIFICATION A-26, 26 MONTH LAG FOR BABY PIGS
AR(1) ADJUSTMENT

Dependent Variable: P_CASH_HOG
Method: Least Squares
Sample(adjusted): 2 157
Included observations: 149
Excluded observations: 7 after adjusting endpoints
Convergence achieved after 11 iterations

Variable	Coeff	Std. Error	t-Statistic	Prob.
P_PORK_CUTOUT	1.003699	0.076650	13.09462	0.0000
P_CORN_LAST33	-2.619973	3.213431	-0.815319	0.4164
P_SOY_LAST33	0.061185	0.025389	2.409895	0.0174
CAN_SLTR_BG	-1.07E-08	3.49E-05	-0.000306	0.9998
CAN_FD_L26	-2.17E-05	2.18E-05	-0.992576	0.3228
FIBGSLT	-0.012190	0.005368	-2.270655	0.0248
FIBGSLT2	3.84E-06	1.72E-06	2.237763	0.0269
MDUM2	-0.184914	1.195299	-0.154701	0.8773
MDUM3	-0.354579	1.394514	-0.254267	0.7997
MDUM4	-0.847330	1.465717	-0.578099	0.5642
MDUM5	0.141720	1.534737	0.092341	0.9266
MDUM6	1.803843	1.548985	1.164533	0.2463
MDUM7	1.007142	1.520923	0.662191	0.5090
MDUM8	-0.195514	1.539103	-0.127031	0.8991
MDUM9	-1.840284	1.505423	-1.222436	0.2238
MDUM10	-3.101364	1.527634	-2.030175	0.0444
MDUM11	-3.110149	1.579808	-1.968688	0.0511
MDUM12	-2.218127	1.489020	-1.489656	0.1387
AR(1)	0.573090	0.077179	7.425497	0.0000

R-squared	0.975785	Mean dependent var	57.06960
Adjusted R-squared	0.972432	S.D. dependent var	12.31752
S.E. of regression	2.045165	Akaike info criterion	4.387456
Sum squared resid	543.7510	Schwarz criterion	4.770509
Log likelihood	-307.8654	Durbin-Watson stat	2.098648

Inverted AR Roots	.57

TABLE 3
SPECIFICATION B-17, 17 MONTH LAG FOR BABY PIGS
AR(1) ADJUSTMENT, INSTRUMENT VARIABLES (TWO STAGE LEAST SQUARES)

Dependent Variable: P_CASH_HOG
Method: Two-Stage Least Squares
Sample(adjusted): 3 157
Included observations: 148
Excluded observations: 7 after adjusting endpoints
Convergence achieved after 12 iterations
Instrument list: P_BF_CUTOUT_HS P_BF_CUTOUT_LS BROILER_P P_BF_CUTOUT_HS(-1) P_BF_CUTOUT_LS(-1) BROILER_P(-1) P_BF_CUTOUT_HS(-2) P_BF_CUTOUT_LS(-2) BROILER_P(-2) MDUM2 MDUM3 MDUM4 MDUM5 MDUM6 MDUM7 MDUM8 MDUM9 MDUM10 MDUM11 MDUM12 FIBGSLT FIBGSLT2 CAN_SLTR_BG CAN_FD_L17 P_CORN_LAST33 P_SOY_LAST33
Lagged dependent variable & regressors added to instrument list

Variable	Coeff	Std. Error	t-Statistic	Prob.
P_PORK_CUTOUT	1.155963	0.096672	11.95753	0.0000
P_CORN_LAST33	-3.007534	2.955420	-1.017633	0.3108
P_SOY_LAST33	0.025261	0.026079	0.968645	0.3345
CAN_SLTR_BG	-9.55E-06	3.50E-05	-0.272929	0.7853
CAN_FD_L17	-8.39E-06	2.26E-05	-0.370538	0.7116
FIBGSLT	-0.015901	0.005189	-3.064318	0.0027
FIBGSLT2	5.18E-06	1.73E-06	2.984628	0.0034
MDUM2	-0.189012	1.209845	-0.156228	0.8761
MDUM3	-0.501366	1.367490	-0.366632	0.7145
MDUM4	-0.660985	1.405944	-0.470136	0.6391
MDUM5	-0.141283	1.488096	-0.094942	0.9245
MDUM6	1.103001	1.544130	0.714319	0.4763
MDUM7	0.823737	1.469229	0.560659	0.5760
MDUM8	-0.084729	1.457324	-0.058140	0.9537
MDUM9	-1.292276	1.429840	-0.903790	0.3678
MDUM10	-2.658098	1.438341	-1.848030	0.0669
MDUM11	-2.977973	1.503695	-1.980438	0.0498
MDUM12	-2.153031	1.435267	-1.500091	0.1360
AR(1)	0.504044	0.080791	6.238899	0.0000

R-squared	0.974967	Mean dependent var	57.10939
Adjusted R-squared	0.971474	S.D. dependent var	12.34973
S.E. of regression	2.085839	Sum squared resid	561.2436
Durbin-Watson stat	2.085016		
Inverted AR Roots	.50		

TABLE 4
SPECIFICATION B-26, 26 MONTH LAG FOR BABY PIGS
AR(1) ADJUSTMENT, INSTRUMENT VARIABLES (TWO STAGE LEAST SQUARES)

Dependent Variable: P_CASH_HOG
Method: Two-Stage Least Squares
Sample(adjusted): 3 157
Included observations: 148
Excluded observations: 7 after adjusting endpoints
Convergence achieved after 13 iterations
Instrument list: P_BF_CUTOUT_HS P_BF_CUTOUT_LS BROILER_P P_BF_CUTOUT_HS(-1) P_BF_CUTOUT_LS(-1) BROILER_P(-1) P_BF_CUTOUT_HS(-2) P_BF_CUTOUT_LS(-2) BROILER_P(-2) MDUM2 MDUM3 MDUM4 MDUM5 MDUM6 MDUM7 MDUM8 MDUM9 MDUM10 MDUM11 MDUM12 FIBGSLT FIBGSLT2 CAN_SLTR_BG CAN_FD_L26 P_CORN_LAST33 P_SOY_LAST33
Lagged dependent variable & regressors added to instrument list

Variable	Coeff	Std. Error	t-Statistic	Prob.
P_PORK_CUTOUT	1.175489	0.098926	11.88249	0.0000
P_CORN_LAST33	-2.977772	2.938464	-1.013377	0.3128
P_SOY_LAST33	0.025908	0.026852	0.964847	0.3364
CAN_SLTR_BG	-1.08E-05	3.47E-05	-0.309887	0.7571
CAN_FD_L26	-2.16E-05	2.29E-05	-0.939791	0.3491
FIBGSLT	-0.015956	0.005197	-3.069980	0.0026
FIBGSLT2	5.16E-06	1.73E-06	2.989464	0.0033
MDUM2	-0.243864	1.211138	-0.201351	0.8407
MDUM3	-0.571514	1.380324	-0.414043	0.6795
MDUM4	-0.764108	1.424586	-0.536372	0.5926
MDUM5	-0.329020	1.512296	-0.217563	0.8281
MDUM6	0.949467	1.562928	0.607493	0.5446
MDUM7	0.549137	1.503843	0.365156	0.7156
MDUM8	-0.287283	1.484873	-0.193473	0.8469
MDUM9	-1.414962	1.446856	-0.977956	0.3299
MDUM10	-2.699590	1.452644	-1.858398	0.0654
MDUM11	-2.852308	1.526744	-1.868229	0.0640
MDUM12	-2.176876	1.445156	-1.506326	0.1344
AR(1)	0.513287	0.079838	6.429126	0.0000

R-squared	0.974911	Mean dependent var	57.10939
Adjusted R-squared	0.971410	S.D. dependent var	12.34973
S.E. of regression	2.088173	Sum squared resid	562.5002
Durbin-Watson stat	2.094571		
Inverted AR Roots	.51		

TABLE 5
SPECIFICATION C-17, 17 MONTH LAG FOR BABY PIGS
DIFFERENCE ESTIMATOR

Dependent Variable: D_P_CASH_HOG
Method: Least Squares
Sample: 1 157
Included observations: 150
Excluded observations: 7

Variable	Coeff	Std. Error	t-Statistic	Prob.
C	1.072088	0.650752	1.647460	0.1019
D_P_PORK_CUTOUT	0.771580	0.097203	7.937808	0.0000
D_CAN_SLTR_BG	-3.68E-05	3.74E-05	-0.982564	0.3276
D_CAN_FD_L17	5.22E-07	1.96E-05	0.026651	0.9788
D_FIBGSLT	-0.013418	0.018312	-0.732773	0.4650
D_FIBGSLT2	3.81E-06	5.15E-06	0.740821	0.4601
D_P_CORN_LAST33	11.25694	30.11235	0.373831	0.7091
D_P_SOY_LAST33	0.011006	0.176046	0.062520	0.9502
MDUM2	-1.495129	0.907751	-1.647069	0.1019
MDUM3	-1.079944	0.895268	-1.206280	0.2299
MDUM4	-1.018370	0.900717	-1.130622	0.2603
MDUM5	-1.365416	0.903616	-1.511058	0.1332
MDUM6	0.221404	0.902024	0.245452	0.8065
MDUM7	-1.217698	0.916567	-1.328543	0.1863
MDUM8	-2.408379	0.944544	-2.549780	0.0119
MDUM9	-0.272140	0.930732	-0.292394	0.7704
MDUM10	-2.017092	0.905094	-2.228599	0.0275
MDUM11	-0.823709	0.965659	-0.853001	0.3952
MDUM12	-1.914891	1.002909	-1.909337	0.0584

R-squared	0.482919	Mean dependent var	0.074200
Adjusted R-squared	0.411869	S.D. dependent var	2.948766
S.E. of regression	2.261399	Akaike info criterion	4.587740
Sum squared resid	669.9245	Schwarz criterion	4.969087
Log likelihood	-325.0805	F-statistic	6.796943
Durbin-Watson stat	2.496579	Prob(F-statistic)	0.000000

TABLE 6
SPECIFICATION C-26, 26 MONTH LAG FOR BABY PIGS
DIFFERENCE ESTIMATOR

Dependent Variable: D_P_CASH_HOG
Method: Least Squares
Sample: 1 157
Included observations: 150
Excluded observations: 7

Variable	Coeff	Std. Error	t-Statistic	Prob.
C	1.079132	0.646672	1.668747	0.0976
D_P_PORK_CUTOUT	0.777441	0.096706	8.039243	0.0000
D_CAN_SLTR_BG	-4.22E-05	3.73E-05	-1.130635	0.2603
D_CAN_FD_L26	-2.52E-05	1.99E-05	-1.268287	0.2069
D_FIBGSLT	-0.012038	0.018188	-0.661882	0.5092
D_FIBGSLT2	3.42E-06	5.11E-06	0.670022	0.5040
D_P_CORN_LAST33	10.44202	29.91824	0.349018	0.7276
D_P_SOY_LAST33	0.014869	0.174965	0.084985	0.9324
MDUM2	-1.465230	0.902516	-1.623494	0.1069
MDUM3	-1.069594	0.889844	-1.202002	0.2315
MDUM4	-1.055693	0.893715	-1.181242	0.2396
MDUM5	-1.375607	0.897675	-1.532411	0.1278
MDUM6	0.211026	0.895845	0.235561	0.8141
MDUM7	-1.195468	0.911138	-1.312061	0.1918
MDUM8	-2.433709	0.938409	-2.593443	0.0106
MDUM9	-0.273666	0.924892	-0.295889	0.7678
MDUM10	-1.958665	0.900646	-2.174734	0.0314
MDUM11	-0.800060	0.959600	-0.833744	0.4059
MDUM12	-1.930061	0.996882	-1.936098	0.0550

R-squared	0.489188	Mean dependent var	0.074200
Adjusted R-squared	0.419000	S.D. dependent var	2.948766
S.E. of regression	2.247648	Akaike info criterion	4.575541
Sum squared resid	661.8019	Schwarz criterion	4.956888
Log likelihood	-324.1656	F-statistic	6.969690
Durbin-Watson stat	2.492241	Prob(F-statistic)	0.000000

TABLE 7
SPECIFICATION D-17, 17 MONTH LAG FOR BABY PIGS
DIFFERENCE ESTIMATOR, INSTRUMENT VARIABLES (TWO STAGE LEAST SQUARES)

Dependent Variable: D_P_CASH_HOG
Method: Two-Stage Least Squares
Sample(adjusted): 3 157
Included observations: 148
Excluded observations: 7 after adjusting endpoints
Instrument list: D_P_BF_CUT_HS D_P_BF_CUT_LS D_BROILER_P D_P_BF_CUT_HS(-1) D_P_BF_CUT_LS(-1) D_BROILER_P(-1) D_P_BF_CUT_HS(-2) D_P_BF_CUT_LS(-2) D_BROILER_P(-2) C MDUM2 MDUM3 MDUM4 MDUM5 MDUM6 MDUM7 MDUM8 MDUM9 MDUM10 MDUM11 MDUM12 D_FIBGSLT D_FIBGSLT2 D_CAN_SLTR_BG D_CAN_FD_L17 D_P_PORK_CUTOUT(-1) D_P_PORK_CUTOUT(-2)

Variable	Coeff	Std. Error	t-Statistic	Prob.
C	-0.373097	1.662481	-0.224422	0.8228
D_P_PORK_CUTOUT	1.031445	0.258358	3.992308	0.0001
D_CAN_SLTR_BG	-2.38E-06	5.18E-05	-0.045846	0.9635
D_CAN_FD_L17	-8.37E-06	2.54E-05	-0.329974	0.7420
D_FIBGSLT	-0.011169	0.023740	-0.470457	0.6388
D_FIBGSLT2	3.23E-06	6.72E-06	0.481435	0.6310
D_P_CORN_LAST33	243.0799	274.8517	0.884404	0.3781
D_P_SOY_LAST33	-0.882970	1.003162	-0.880187	0.3804
MDUM2	-1.224509	1.176706	-1.040625	0.3000
MDUM3	-0.742473	1.169366	-0.634937	0.5266
MDUM4	-0.183411	1.346402	-0.136223	0.8919
MDUM5	-0.682303	1.380714	-0.494167	0.6220
MDUM6	0.926247	1.381865	0.670288	0.5039
MDUM7	0.796318	2.142817	0.371622	0.7108
MDUM8	-0.342193	2.037826	-0.167920	0.8669
MDUM9	1.530926	2.427717	0.630603	0.5294
MDUM10	-0.083431	2.095453	-0.039815	0.9683
MDUM11	0.413459	1.848041	0.223728	0.8233
MDUM12	-0.640809	2.043272	-0.313619	0.7543

R-squared	0.219100	Mean dependent var	0.054122
Adjusted R-squared	0.110137	S.D. dependent var	2.961725
S.E. of regression	2.793871	Sum squared resid	1006.937
F-statistic	3.099455	Durbin-Watson stat	1.818086
Prob(F-statistic)	0.000102		

TABLE 8
SPECIFICATION D-26, 26 MONTH LAG FOR BABY PIGS
DIFFERENCE ESTIMATOR, INSTRUMENT VARIABLES (TWO STAGE LEAST SQUARES)

Dependent Variable: D_P_CASH_HOG
Method: Two-Stage Least Squares
Sample(adjusted): 3 157
Included observations: 148
Excluded observations: 7 after adjusting endpoints
Instrument list: D_P_BF_CUT_HS D_P_BF_CUT_LS D_BROILER_P D_P_BF_CUT_HS(-1) D_P_BF_CUT_LS(-1) D_BROILER_P(-1) D_P_BF_CUT_HS(-2) D_P_BF_CUT_LS(-2) D_BROILER_P(-2) C MDUM2 MDUM3 MDUM4 MDUM5 MDUM6 MDUM7 MDUM8 MDUM9 MDUM10 MDUM11 MDUM12 D_FIBGSLT D_FIBGSLT2 D_CAN_SLTR_BG D_CAN_FD_L26 D_P_PORK_CUTOUT(-1) D_P_PORK_CUTOUT(-2)

Variable	Coeff	Std. Error	t-Statistic	Prob.
C	-0.315639	1.640124	-0.192448	0.8477
D_P_PORK_CUTOUT	1.060893	0.256634	4.133876	0.0001
D_CAN_SLTR_BG	-6.79E-06	5.09E-05	-0.133356	0.8941
D_CAN_FD_L26	-2.43E-05	2.50E-05	-0.973683	0.3320
D_FIBGSLT	-0.009729	0.023454	-0.414807	0.6790
D_FIBGSLT2	2.84E-06	6.64E-06	0.427878	0.6695
D_P_CORN_LAST33	231.2846	272.3680	0.849162	0.3974
D_P_SOY_LAST33	-0.840984	1.002879	-0.838570	0.4033
MDUM2	-1.207228	1.159275	-1.041365	0.2997
MDUM3	-0.734890	1.152597	-0.637595	0.5249
MDUM4	-0.224722	1.340582	-0.167630	0.8671
MDUM5	-0.757568	1.356167	-0.558610	0.5774
MDUM6	0.881500	1.370185	0.643344	0.5211
MDUM7	0.760986	2.119962	0.358962	0.7202
MDUM8	-0.411671	2.001565	-0.205674	0.8374
MDUM9	1.430975	2.401590	0.595845	0.5523
MDUM10	-0.069196	2.059942	-0.033591	0.9733
MDUM11	0.378688	1.824048	0.207609	0.8359
MDUM12	-0.696401	1.996105	-0.348880	0.7277

R-squared	0.241000	Mean dependent var	0.054122
Adjusted R-squared	0.135093	S.D. dependent var	2.961725
S.E. of regression	2.754415	Sum squared resid	978.6977
F-statistic	3.259437	Durbin-Watson stat	1.876697
Prob(F-statistic)	0.000049		

8. Appendix B – Data Listing