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U.S. Net Farm Income, 1913 - 2012

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Background

Financial indicators for the U.S. farm sector are strong. Net farm income approached \$100 billion in 2011 (figure 1). Prices of major farm products (corn, soybeans, wheat, cattle) have increased significantly over the last few years. Some wonder if a new normal has been reached with respect to high output prices fueling continued strong returns in agriculture (Boehlje et al., 2012). Causes for the expectations of continued high prices in agricultural commodity markets include global population growth, rising income levels, falling dollar values, and increasing industrial demands for agricultural output. However, Boehlje et al. (2012) and Henderson (2011) question if recent incomes are sustainable or if, like previous booms, market forces will return farm incomes to long term averages.

Objectives

1. Identify the sensitivity of U.S. NFI to output prices and input costs between 1913-2012
2. Identify the sensitivity of U.S. NFI annual changes to annual revenue and cost changes
3. Determine roles of annual changes in prices and quantities in annual NFI variability

Objective 1

Assume agents in the sector act to maximize NFI. By the envelope theorem and logarithmic transformation of NFI, NFI shares for outputs and inputs represent the sensitivity of NFI to changing prices,

Consequently, $\epsilon_{NFI, P}$ measures the elasticity of NFI with respect to *price*. Figures 2-4 illustrate NFI sensitivity has been increasing over the last 100 years, with large spikes in 1975-1985. The largest increases in sensitivity have occurred in inputs (e.g., sensitivity of NFI to manufactured input prices have increased 1240% since the beginning of the period).

Fig 1. NFI, 1913- 2012

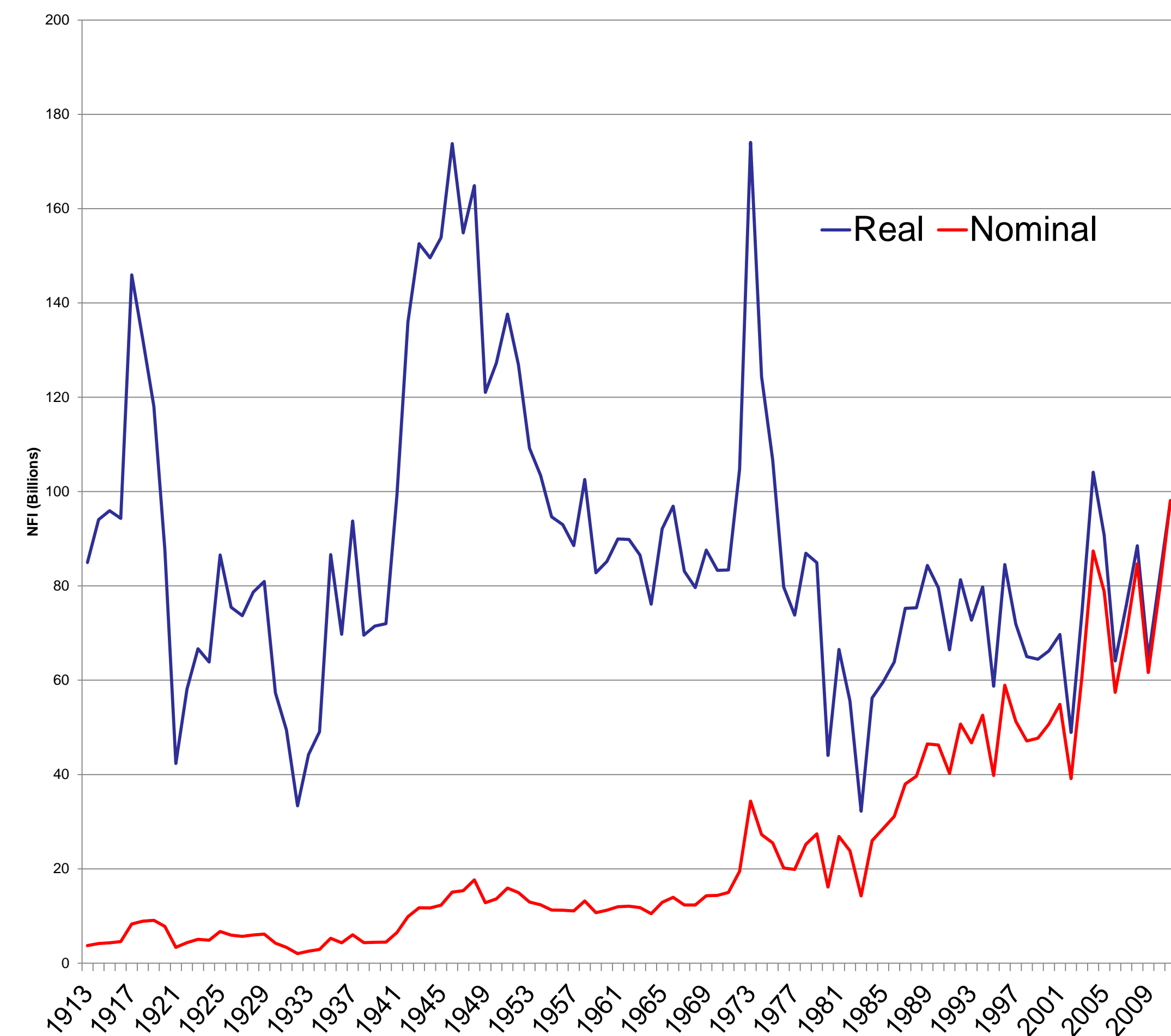


Fig 2. NFI Sensitivity to Output Price

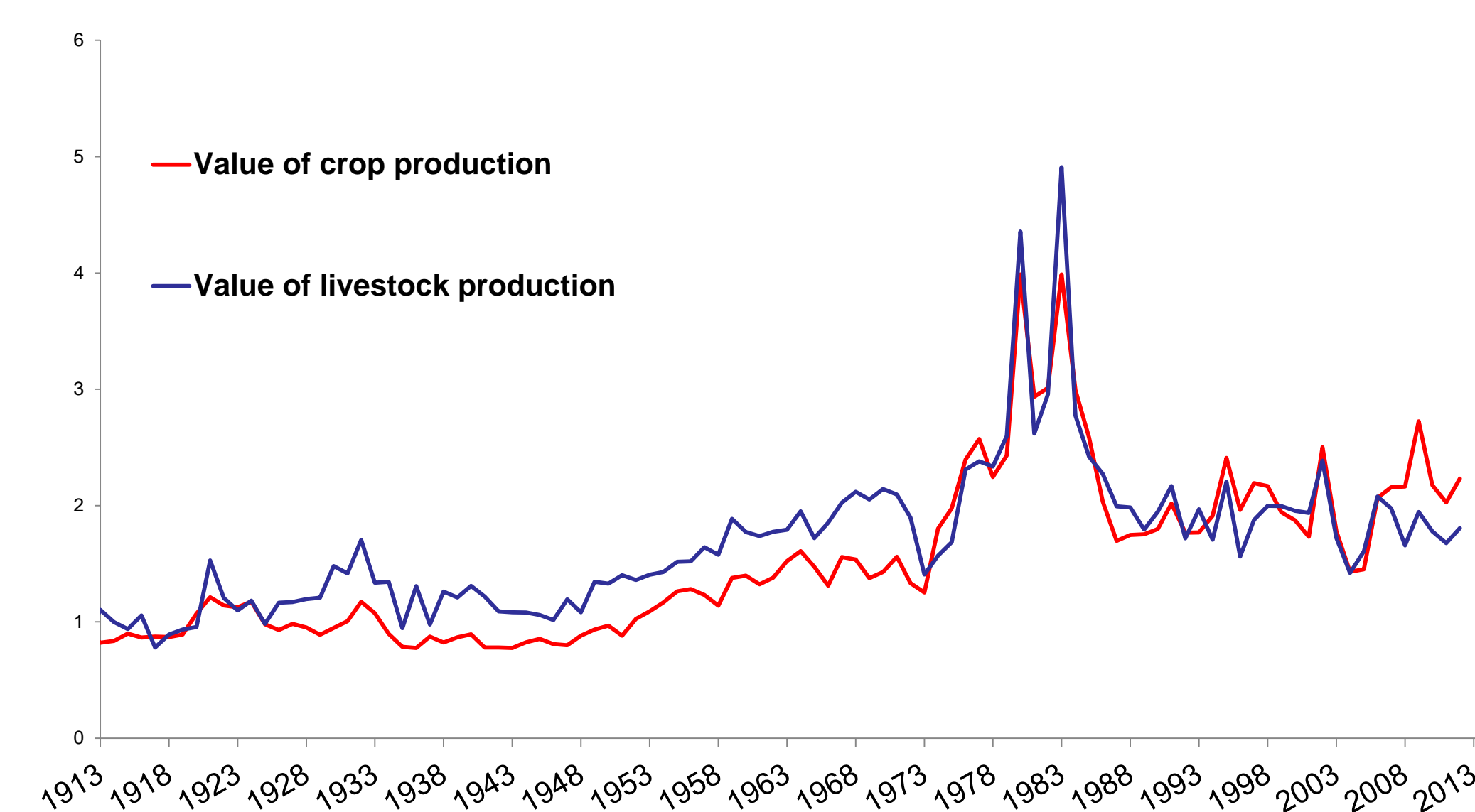


Fig 3. NFI Sensitivity to Variable Input Price

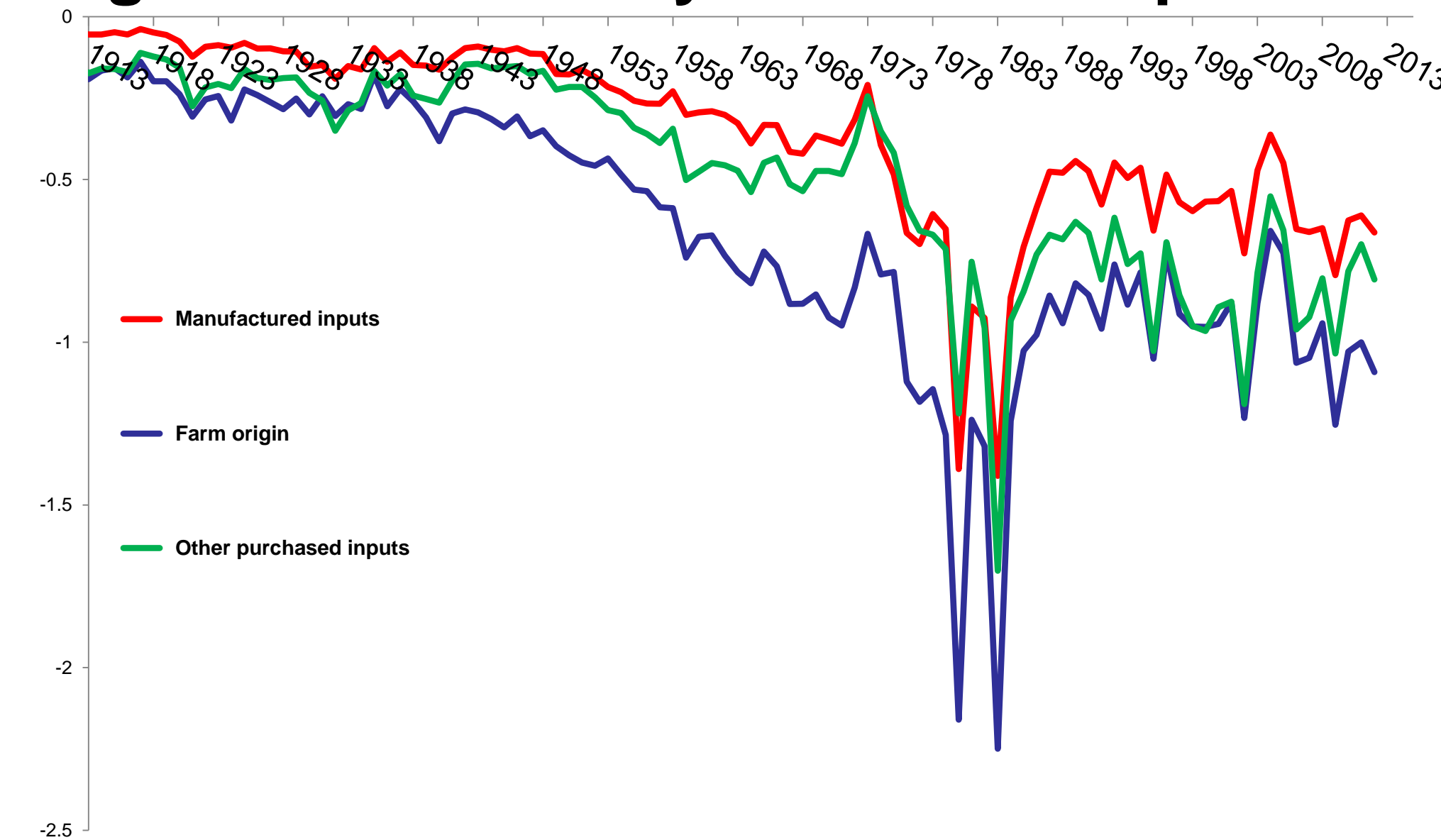
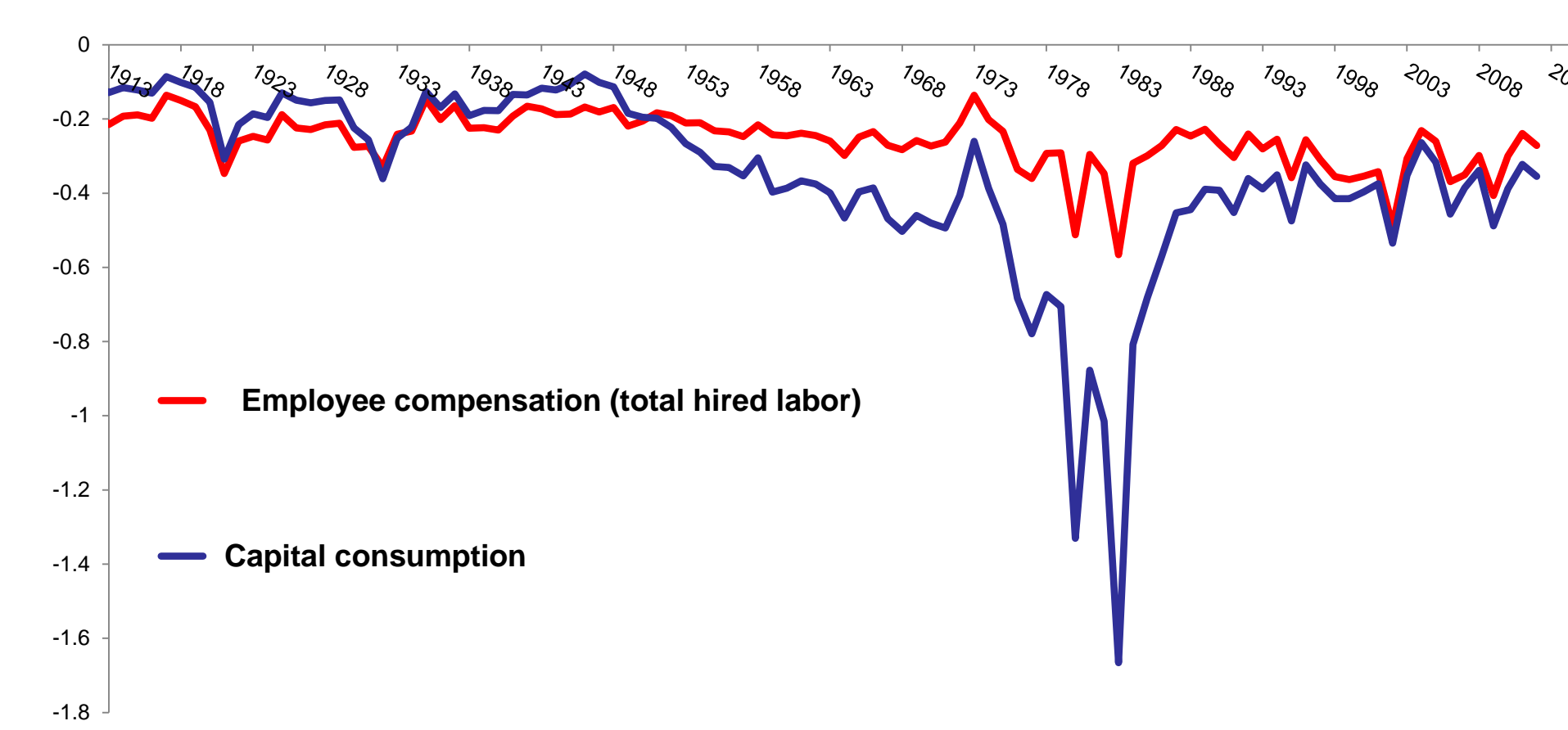


Fig 4. NFI Sensitivity to Labor & Capital Price



Objective 2

Annual changes in NFI can be decomposed to changes in revenues and expenses. Results of an OLS model are over the 1913-2012 period are:

$$\begin{aligned} \Delta NFI = & 0.027 + 1.083\Delta CROP + 1.464\Delta LVSK \\ & - 0.370\Delta FARM - 0.042\Delta MANU \\ & - 0.624\Delta PURCH - 0.411KAP \\ & - 0.396LABR, \end{aligned}$$

$$r^2 = 0.859$$

RHS variables are revenues or expenditures. All coefficients are significant at the 5% or better level except for manufactured inputs (MANU).

Objective 3

Annual changes in NFI result from changes in revenues and expenses. Specific changes in a categories revenues (or costs) can be decomposed: $\Delta(pq)_t = p_{t-1}\Delta q_t + q_{t-1}\Delta p_t + \Delta p_t \Delta q_t$. Since the ERS NFI accounts do not disaggregate prices and quantities, the relative impacts of each was measured using OLS similar to under objective 2, but using Ball's aggregate productivity indexes four outputs, labor, capital except land, and miscellaneous inputs. Annual change data were available for 1949-2009.

$$\begin{aligned} \Delta \pi = & 0.052 + 6.373^* \Delta P_{OUT} + 7.672^* \Delta Q_{OUT} \\ & - 1.611^* \Delta W_{LABR} - 1.774 \Delta X_{LABR} \\ & - 0.588 \Delta W_{KAP} - 0.430 \Delta X_{KAP} \\ & - 3.460^* \Delta W_{MATL} - 2.91^* \Delta X_{MATL} \end{aligned}$$

- - significant at least at the 5% level
- $$r^2 = 0.804$$

Conclusions

1. NFI has become increasingly sensitive to output and input prices in the last 40 years, with most of the sensitivity occurring with input prices.
2. The annual changes in NFI have been growing over time.
3. Changes in NFI are statistically significantly and positively affected by crop and livestock production values and negatively affected by expenditures on inputs of farm origin, purchased inputs, capital services, and labor.
4. Over the last 100 years, NFI changes have been influenced most strongly by crop and livestock production values.
5. The significant impact of agricultural output is further reflected using disaggregated prices and quantities. Changes in output price and quantity are both statistically significant in explaining profit changes.
6. On the input side, prices of labor and prices and quantities of materials used are statistically significantly associated with changes in NFI. The impacts of changes in prices and quantities of capital (excl. land) and quantity of labor have not significantly affected profit changes over 1949-2009.

The statistical results identify sources of positive changes in NFI over the last decade. For example, NFI increased 24% between 2010 and 2011. Although costs increased 45%, revenues increased 69% as commodity prices increased due to global supply and demand conditions. The OLS results from objective 2 demonstrate effects of revenue changes on NFI have traditionally exceeded the effects of cost changes. Recent experience reflects this long-term relationship. Not surprisingly, so long as the positive changes in the value of farm production exceeds cost increases, NFI will continue positive growth.

References

Boehlje, Mike, Brent Gloy, and Jason Henderson. 2012. "U.S. Farm Prosperity and Rural America: The New Normal or Reversion to the Mean?" Paper presented at the 2012 ASSA meeting, Chicago, IL. January 6, 2012.

Henderson, Jason. 2011. "Is This Farm Boom Different?" Main Street Economist. Issue V. Available at: http://www.kansascityfed.org/publicat/mse/MSE_0511.pdf