

Decoupled Payments: A Dynamic, Economywide Perspective

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Abstract

This report demonstrates the relationship, over time and in an economywide context, between the decoupled payments to U.S. agricultural producers and market/trade distortions. If agricultural capital markets are complete, decoupled payments have longrun effects on land rents and land values, but they have no effect on production. If capital markets are not complete, production effects are small (0.2 percent) in the short run and disappear in the long run. The only permanent effects are on land rental rates and, therefore, on land values, which increase by about 10 percent in the short run tapering off to slightly above 8 percent in the long run.

Keywords: Decoupled payments, intertemporal, land values.

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Introduction

The 1996 Federal Agriculture Improvement and Reform Act introduced new producer supports known as “production flexibility contract” (PFC) or decoupled payments [fixed payments] tied to historical base acreage and yields.² Do these decoupled payments to farmers alter resource allocation and production over time such that they affect agricultural markets?

Decoupled PFC payments are lump-sum income transfers to farm operators; the payments do not depend on current production, factor use, or commodity prices. Such payments are not constrained by global trade rules, but many countries argue that they distort production and trade and that their use should be limited. The question is not whether PFC payments change recipients’ consumption patterns, investment patterns, or labor-leisure choices. Instead, the question is whether these payments affect agricultural markets. The purpose of this report contributes to this debate by considering the intertemporal effects of decoupled payments on market behavior.

If markets are complete, and taxed and recipient households have similar preferences, then PFC payments can be an efficient policy instrument to transfer resources from one segment of the population to another with no deadweight losses. Even if agricultural capital markets are not perfectly integrated with capital markets in the rest of the economy, decoupled payments cause minimal market distortions. A possible exception is the indirect effects on (boost to) land values, which can increase landowners’ access to credit. In the real economy, however, farmers anticipate future farm programs and make production decisions in keeping with projected payments.

Also, markets may not be complete due, for example, to the presence of fixed costs, absent and incomplete risk markets, and the fact that taxed and program recipients do not hold identical and homothetic preferences over goods and services. However, these other market conditions are outside the scope of this analysis and their influence on whether decoupled payments distort markets.

Basic Concepts

Over time, the recipients of transfer payments are likely to consume more goods, including leisure, and to increase savings. However, whether these individual decisions affect resource allocation and supply of agricultural commodities at the market level depends on the behavior of those that are taxed to provide the transfer (see appendix for details of the analysis and its main agents and features, and Roe et al., 2002).

² See USDA, ERS, AER 822, 2003, and Orden et al., 1999, for a discussion of these programs.

The investment and consumption effects on those taxed can be exactly offset by effects on recipients such that, after the transfer, resource allocation and production at the market level are unaffected. In principle, this outcome is expected when capital markets work perfectly in allocating savings to investors in all sectors of the economy, when risk markets are complete in the sense of opportunities to insure against future contingencies, and when rural households (or recipients of the transfer) have consumption/savings preferences indistinguishable from other households. Under these circumstances, the wealth effect of a transfer on recipient behavior is offset by the negative wealth effect of those taxed to provide the transfer. If consumption-savings preferences vary, then direct payments can have market-level effects because the lesser savings of the individuals taxed might not match greater savings of recipients.³

Of course, in real economies, ideal market conditions do not prevail. As Stiglitz (1985, p. 21) argued, markets fail in the optimal provision of information, and “theory is not robust to slight alterations in informational assumptions.” Empirical estimates of the value of information in risky markets by Antonovitz and Roe (1986) support subsequent contentions that agent’s subjective forecasts of future events (the importance of information) dominate the small effects of risk preferences on production decisions. Sandmo (1971) and Hirshleifer (1988) showed that individual and market behavior under risk is affected by specific features of capital markets, such as the presence of liquidity constraints. Other forms of market failure include fixed costs, a point raised by Chau and de Gorter (2000). Further, the presence of other policies might also cause decoupled payments to be minimally trade-distorting in the world of “second best” (Mas-Colell, Whinston, and Green, 1995, p. 710). Then, policies that are viewed as trade distorting in an ideal economy can enhance welfare in a real economy. In our view, these conditioning factors should, in principle, be evaluated when analyzing whether an instrument is likely to be minimally trade-distorting.

Two additional factors may cause decoupled payments to distort markets:

- if agricultural capital markets differ from nonfarm capital markets, and
- if payments are linked to land that was planted to program crops in the base period.

We now turn to a discussion of these two issues.

Unlike corporations, farmers cannot issue securities or bonds to finance farm activities; instead, they must rely on land and other assets for collateral. Corporations tend not to invest directly in the production of program crops, although contract production for broilers, eggs, and hogs is common. Thus, diverged capital markets can have different capital effects on individuals outside agriculture that are taxed than on recipients in agriculture. This effect might be greater if, all else equal, farmers face liquidity constraints or if they have a preference for investing in agriculture the proportion of decoupled payments not allocated to consumption. The difference in these diverged capital markets does not imply that returns to capital in agriculture departs from returns in

³ More specifically, if individual preferences are identical but non-homothetic, then marginal propensities to consume and save can differ among individuals of different income levels. In this case, the behavior of recipients can differ from the behavior of those taxed with the result that transfer payments can affect market allocations over time.

other sectors of the economy, at least in the long run, since farm households also invest in stocks, bonds, and other economywide financial instruments (see USDA, ERS, AER-822, 2003). In the short run, an increase in agriculture's capital stock should have production and, hence, market effects. The question is whether such an effect is large.

A related issue is that direct payments are targeted to land planted to program crops in the base period. This linkage is important because land is an asset and, as such, individuals, with other assets they own, should, in principle, attempt to equate their returns across their portfolio (after adjusting for risk and deferred capital gains). This condition is expected to prevail among assets when capital markets work perfectly in maximizing returns to savings.⁴ Since direct payments are targeted to operators of land planted to program crops in the base period, the cash rental rate that a tenant is willing to pay for an acre of land is affected by the payment and, consequently, so is the price of land. A change in the price of land affects its value as an asset, which affects wealth, and can consequently affect investment and consumption behavior. Since land is used as collateral, payments can, in principle, increase farmers' access to credit. Goodwin et al. (2002, 2003a, 2003b) and Barnard et al. (2001) found that decoupled payments have had small effects on land values, ranging from 2 to 6 percent in the Northern Great Plains and Corn Belt regions. Our analysis suggests somewhat larger effects.

Analysis

Since the above discussion implies that an economywide approach is required to assess whether direct payments are likely to affect resource allocation and production, we report the results from an inter-temporal multisector model of the U.S. economy. Savings are endogenous, and assets are aggregated into three broad categories--capital in agriculture, capital not in agriculture, and land. We fit two versions of the model to data. One version presumes that the capital markets for agriculture and the rest of the economy are perfectly integrated so that any differences in short run rates of return to capital and land are instantly arbitrated to zero. In the second version, where we relaxed this assumption to limit recipients' investment alternatives to agricultural assets, the rates of return diverge only in the short run. Otherwise, the models are identical in their specifications. Households are presumed to hold identical homothetic preferences over their consumption of goods and services. Most of the model's parameters are based on the year 1997, while rates of growth in total factor productivity, growth in the U.S. labor force, and selected other parameters are taken from other research for the baseline run (see Roe, 2001, for an overall discussion of the basic framework and the appendix for a sketch of the analytical model). The model is found to reproduce some key outcomes observed for the actual economy for 1997 to 2001.

Land Values Appear To Be Linked to Government Payments

Many studies documented that decoupled payments, even though they aim to benefit farm households, have an important side effect--to raise land values. For example, Barnard et al., 2001, evaluated the responsiveness of cropland values to changes in

⁴ Barro and Sala-I-Martin, 1995, p. 99, discuss the implications of this condition for capital.

government payments and documented the interaction between direct payments and land values. Goodwin et al., 2003b, using cross-sectional data over the period 1998-2000 confirm that policy affect land values even though different policies have very different effects on land values.

Effects of Decoupled Payments on Resource Allocation and Production are Surprisingly Small

We assumed that decoupled payments, equal to \$6.112 billion in 1997, are made to farmers each year from 1997 on. Thus, the results from this report should be interpreted as suggesting the directional effects of direct payments as opposed to placing undue emphasis on magnitude. All reported results are compared with the base. The base is the path of the economy in the absence of direct or other payments to farmers.

The Case of Integrated Capital Markets. This analysis presumes that investors allocate savings at each instant of time so as to arbitrage away any differences in rents to the three assets (land, agricultural capital, and capital in the manufacturing and service sectors). Effectively, at each instant of time, the rate of return to agricultural capital is equated to the returns to capital in the rest of the U.S. economy. Since preferences are identical, consumption and investment behavior of the recipients of decoupled payments are exactly counter balanced so that no net resource allocation effects are observed. This is the case where payments are completely decoupled, even inter-temporally. However, since payments are linked to land planted to program crops, land values are affected (fig. 2), thus supporting the work of Goodwin et al. (2002, 2003a) and Barnard et al. (2001). We find that the \$6.112 billion payment, in the short run, causes land values to exceed their base-level values by almost 9 percent and then taper off to about 8.3 percent above their long run base value.

These effects are due solely to the decoupled payments. Competition for land (and a right to the transfer) causes renters to pay higher rates to owners. If the land is sold, the buyer is willing to pay more if the payment remains tied to the land. The rise in land values is due to the capitalization of the future stream of government payments, not to the secular rise in agriculture's total factor productivity and the capital deepening that are common to the base run and the analysis incorporating direct payments.

Of course, decoupled payments and the rise in land values change recipients' consumption patterns and level of assets (fig. 3, and app. equations 25-27). Our results suggest that, in the short run, asset values of recipient households rise by about 2 percent above their base values, due mostly to the rise in land values. Most of the payments are spent on final goods; this proportion rises over time while the proportion saved falls. Total consumption expenditures are about 0.8 percent higher than expenditures in the absence of transfers. The rise in the value of assets held by recipient households should also increase their access to credit. If liquidity constraints are binding, then this aspect of PFC payments may not in fact be decoupled.

The Case of Segmented Capital Markets. The analysis above reproduces the directional effects that Goodwin et al. (2002, 2003a, 2003b) and Barnard et al. (2001) found on land values. We repeat the analysis, but no longer allow agricultural capital

markets to be perfectly arbitrated with capital markets in the rest of the economy at each instant of time, although they are in the long run. Within agriculture, and within the rest of the economy, all capital rents are arbitrated away.

Returning to figure 2, the value of land exceeds the value of land when markets are perfectly arbitrated by roughly 1 percent in the short run. The reason for this result can be seen from figures 4 and 5.

Figure 4 shows the percentage change from the base of decoupled payments on the capital rental rate outside agriculture, on the rental rate in agriculture, and, more generally, on the index of wages and other prices. The results show that, within the first 10 years of payments, the rental rate on agricultural capital declines by a modest 0.1 percent below the capital rental rate observed in the base solution. This rate equaled 6.48 percent in year five. The effect on the capital rental rate outside agriculture and on the price index of goods is almost imperceptible. Notice also that even though the direct payments in equal amounts continue throughout the period, agriculture's capital rental rate slowly converges to that of the rest of the economy. In other words, in spite of the presumed differences between agriculture and the rest of the economy, in the long run, direct payments do not distort the rate of return to capital in agriculture.

The decline in agriculture's rate of return to its capital stock affects the price of land by way of the market clearing condition for maximizing returns to savings. This condition amounts to equating, at each instant in time t , the rate of return to agriculture's capital stock $r_a(t)$ to the ratio of land rent, including PFC payments to the price of land plus the rate of change in the price of land, or as follows:

$$r(t) = \frac{\pi(t)}{P(t)_{land}} + \frac{\dot{P}(t)_{land}}{P(t)_{land}},$$

where $\pi(t)$ is the land rental rate including PFC payments, P_{land} is the price, or value, of land and $\dot{P}_{land}$ is the change in the price of land. The solution to this differential equation (simultaneously with other equations in the model) yields the evolution in the price of land over time. As the interest rate falls, all else held constant, the rental rate of land rises due to capital deepening, which in turn causes the value of land to rise. Since farmers are assumed to invest their savings in agriculture in the segmented case, all else constant, the diminishing returns to the growth in agriculture's capital stock (shown in fig. 5) causes the rate of return to decline and land prices in the first 5 years of the simulation to rise to a greater extent than in the case where capital markets are presumed to be non-segmented (fig. 2). After 5 years, land values (while still rising) become slightly lower than in the segmented case. Effectively, in the presence of decoupled payments, the segmented capital market speeds up agriculture's capital accumulation and convergence to its long run equilibrium.

Figure 5 shows why direct payments cause the rental rate of agricultural capital to decline. In early periods, farmers tend to allocate a relatively larger proportion of their

payments to investment in agricultural capital than in later periods. In the short run, the amount of capital invested in agriculture rises to about 0.25 percent of the capital stock than would otherwise be accumulated (relative to the base). As additional capital investments lead to diminishing returns to capital stock, farmers save less and spend an increasingly larger share of their decoupled payment on final goods. In the long run, the amount of capital employed in agriculture is equal to the amount that would be employed in the absence of transfer payments; in other words, payments do not affect the long run level of capital stock in the sector. Nevertheless, the half-life of the adjustment is about 25 years because the depreciation rate for buildings and structures is relatively small. The effect on capital stocks in the rest of the economy is almost imperceptible.

As farmers increase their levels of capital stock, more labor hours, relative to the base, are also allocated to production (fig. 6). The increased hours accrued from a combination of reduced leisure time and an increased hired labor.⁵ Again, the magnitude is relatively small. However, as figure 7 shows, PFC payments encourage the employment of capital relative to labor. That is, the capital-to-labor ratio rises, relative to the base, because the presumed preference for investing in agriculture causes the rate of return to capital to fall slightly relative to the change in wages. The change in this ratio encourages an increase in the substitution of capital for labor relative to the base. In the long run, the ratio converges to the level expected in the absence of payments.

Finally, do the resource re-allocation effects of PFC payments affect aggregate agricultural production? Figure 8 suggests that U.S. agricultural production rises by a maximum of about 0.18 percent of its base value in the short run, but in the long run, returns to levels that would prevail in the absence of payments. That is, even if payments are made into the indefinite future to farmers at approximately the levels of 1997, they have no long run effect on production. The effects that prevail into the long run are the elevated price of land (fig. 2), and land rental rates (fig. 8).

Conclusions

The general question addressed is whether decoupled payments to farmers are likely to cause market effects. We consider this question in an economywide context because the market effects of those taxed to provide the transfer might offset the market effects of the recipients of the transfer. If this result obtains, decoupled payments can be thought of as an efficient policy instrument to transfer resources from one segment of the population to another, with no deadweight losses and, hence, minimal trade distortion. Since the real economy is obviously complicated and encumbered with incomplete markets, this is a complex question. Our contribution lies in showing the circumstances, over time, under which payments have minimal market distortions and, for the case where capital markets are not complete and/or liquidity constraints prevail in agriculture, just how distorting these payments might actually be.

⁵ Since leisure is typically found to be a normal good, although not modeled explicitly in this report, the combination of wealth and price effects would likely leave the average level of leisure consumed by farmers to be virtually unchanged. The slight increase in agricultural labor in the segmented market case relative to the base year, comes from the hired labor market. Nevertheless, in absolute terms, in all of the analysis, there is an out migration of labor from agriculture.

Our economywide analysis finds that if agricultural capital markets are perfectly integrated with capital markets in the rest of the economy and if the taxed and recipients hold identical and homothetic preferences for goods and services, then the key effects of payments over time are to increase the value of land by about 8 percent and, of course, to increase the wealth of program recipients and their expenditures on final goods. None of these effects are trade distorting. The exception, which we do not investigate, is that, since land can be used as collateral, it potentially provides farmers access to more credit than would otherwise be the case.

If we presume that farmers, all else constant, prefer to invest in agriculture the increment of the decoupled payments not spent on consumption, then we find some evidence that payments affect resource allocation and production. But, these effects are small, and they persist only in the short run. In this case, in the short to intermediate run, direct payments tend to cause capital deepening and to increase agricultural output. However, these effects are extremely minimal. They cause aggregate agricultural production to rise by less than 0.2 percent in the short run.

Direct payments are a relatively efficient policy instrument for transferring income from the rest of the economy to farmers. They are “efficient” in the sense that they have relatively small effects on agricultural resource allocation and production. In the long run, payments cause no resource allocation and output effects. The only long-term effect of payments is to increase land values and land rental rates.

Appendix

The Analytical Model

A summarized version of the analytical model underlying the results presented in the various figures is briefly sketched here. Neither comparative static results nor proofs of existence are presented. For the full version of the model see Roe et al., 2002. The basic model is presented first, followed by a discussion of the two adaptations to account for decoupled payments and decoupled payments in the presence of segregated capital markets.

The Environment

The model depicts an open economy in which agents consume and produce at each instant of time a manufacturing good, an agricultural good, and a home good. These goods are indexed, $j = m, a, s$, respectively. The manufacturing good can also be allocated to capital. The agricultural and manufacturing good can be traded internationally at given prices, p_m and p_a . Labor services are not traded internationally and domestic residents own the entire stock of domestic assets. The home good is traded only in the domestic economy at endogenously determined price p_s . Households are of two types (indexed $i = u, o$). They may be thought of as denoting urban households that own no land and other mostly rural households that own land. The only distinguishing features are their endowments of labor, capital (assets), and agricultural land. Their utility functions describe identical preference relations. Households purchase goods (C_{ij}), consume them, and earn income by providing labor services (L_i) in exchange for wages (w), earn interest income at rate (r) on capital assets (A_i), and receive rents (π_i) from agriculture's sector-specific resource, land (T). The manufacturing and home good sectors employ labor and capital services, while, agriculture employs the services of land. Two basic versions of the model are considered, one where the arbitrage condition between assets is presumed to hold and another where the market for agricultural capital can clear at a rate of return different from the capital employed in the manufacturing and service sectors of the economy.

Firms

The manufacturing and home-good sectors ($j = m, s$) employ constant returns to scale technologies that, at the sector level, can be expressed as

$$Y(t)_j = F^j(A(t)L(t)_j, K(t)_j), j = m, s, \quad (1)$$

where labor productivity grows at the exogenous rate x ,

$$A(t) = e^{xt}.$$

Agriculture's sector-level technology is taken to be constant returns to scale (CRS) in all of its arguments, although land T , which can be rented among farmers, is assumed to be specific to the sector. The technology,

$$Y(t)_a = F^a(A(t)L_a, K_a, A_a(t)T),$$

can be expressed in per capita terms as

$$\hat{y}_a = l_a f^a(\hat{k}_a, \hat{T}_a), \quad (2)$$

where $l_a = L_a / L$ is the share of total labor employed in agriculture, and land, in effective units per worker in agriculture, is denoted by $\hat{T}_a = A_a(t)T / A(t)L_a$. Thus, in addition to exogenous growth in labor's productivity at the same rate as other sectors, $A(t)$, land's productivity can also grow exogenously as determined by⁶.

$$A_a(t) = e^{\eta t}$$

Households

Households' choice are expressed in efficiency units. The typical *ith* household's utility from consuming the sequence $\{\hat{c}_{im}, \hat{c}_{ia}, \hat{c}_{is}\}_{t=0}^{t=\infty}$ is expressed as a weighted sum of all future flows of utility

$$\int_{t=0}^{t=\infty} \frac{u(\hat{c}_{im}, \hat{c}_{ia}, \hat{c}_{is})^{1-\theta} - 1}{1-\theta} e^{(n-p)t} dt, \quad (3)$$

where goods, $\hat{c}_{ij} = C_{ij} / A(t)l_i$, are expressed in efficiency units per household member. The number of members are assumed to grow at the exogenously given positive rate n ,

$$l_i = e^{nt}, i = u, o,$$

and to discount future consumption at the rate $\rho > 0$. The elasticity of inter-temporal substitution is given by $1/\theta$, where $1 \geq \theta > 0$. For the purpose of this analysis, we specify a constant returns to scale Cobb-Douglas form of $u(\hat{c}_{im}, \hat{c}_{ia}, \hat{c}_{is})$ and normalize the number of household members in such a way as to equal the number of workers. For details on the intertemporal behavior of urban and rural household budget constraints and expenditures, see Roe et al., 2002.

Behavior of Households and Firms

Households choose positive values of the sequence $\{\hat{c}_{im}, \hat{c}_{ia}, \hat{c}_{is}\}_{t=0}^{t=\infty}$ to maximize equation 3 subject to their respective budget constraints, their stock of initial assets $\hat{k}_i(0)$, $\hat{T}$, and a limitation on borrowing. For the first-order conditions obtained from the present-value Hamiltonian see Roe et al., 2002.

Competition among firms in agriculture implies that gross returns are just sufficient to cover total factor cost, including returns to land. In this case, the sector's gross domestic product function, in units of effective total labor, can be expressed as:

⁶ Thus, the framework allows growth in agriculture's total factor productivity (that is, Solow's residual) to equal or exceed that of manufacturing and services, as has been found in other studies.

$$\hat{\pi} = \boldsymbol{\pi}(\rho_\alpha, \hat{w}, r) \hat{T} \equiv \underset{(l_\alpha, \hat{k}_\alpha)}{Max} l_\alpha \{ p_\alpha f^a(\hat{k}_\alpha, \hat{T}_\alpha) - \hat{w} - r \hat{k}_\alpha \},$$

where $\hat{T} = A_a(t)T / A(t)L$. The land rental rate $\boldsymbol{\pi}(p_a, \hat{w}, r)$ is the rate per effective unit of land per capita required for the rental market among farmers to clear. The gradients of $\boldsymbol{\pi}(p_a, \hat{w}, r)$ yield agricultural supply and labor and capital demand per effective unit of land per capita.

Equilibrium

A competitive equilibrium for this economy is a sequence of positive values for prices, firm allocations, and household allocations given economywide aggregates of prices of agricultural and manufacturing goods, and the stock of initial assets (for details, see Roe et al., 2002).

The no-arbitrage condition between the assets of capital and land to assuring the optimal allocation of savings, (providing the returns to the two types of investment are equal):

$$r^* = \frac{\boldsymbol{\pi}(p_a, \hat{w}^*, r^*)}{P_{land}^*} + \frac{\dot{P}_{land}^*}{P_{land}^*}. \quad (11)$$

This equation is implicit in the statement of the r th household's budget constraint. It states that returns to savings are maximized when the income in $t + dt$ from one unit of income invested in physical capital equals r , which must equal the same return in $t + dt$ to a unit of income invested in land. The returns to one unit of income invested in land is $\boldsymbol{\pi}(p_a, \hat{w}^*, r^*) / P_{land}$ plus capital gains in the amount of $\dot{P}_{land} / P_{land}$ per unit of land.

For the specification of the intra-temporal conditions at each instant of time, that is the clearing conditions of the various markets and zero profits in the manufacturing and services sectors, as well as the condition for the steady state solution, see Roe et al., 2002.

Accounting for Direct Payments

The model is calibrated to U.S. data for 1997 and solved under the assumption of no PFC payments. This generates a base sequence of the endogenous variables (see Roe et al., 2002). Decoupled payments are added to the model and the urban and rural household budgets constraints changed according to:

$$\dot{A}_u = w l_u + r A_u - PFC - E_u, \quad (12)$$

and

$$\dot{A}_o = w l_o + r A_o + \left[\boldsymbol{\pi}(p_a, \hat{w}, r) \hat{T} + \frac{PFC}{T} \right] T - E_o, \quad (13)$$

respectively. This presumes (i) a lump-sum transfer of PFC from non-land-owning households to land-owning households, (ii) that the transfer is tied to the ownership of land, and (iii) that this payment is made at each instant of time in perpetuity.

The no-arbitrage condition between assets equation 11 now becomes

$$r = \frac{\pi(p_a, \hat{w}, r) + PFC/T}{P_{land}} + \frac{\dot{P}_{land}}{P_{land}}. \quad (14)$$

This differs from the equation on page 14 in this report in its use of decoupled term. Through the household budget constraints, the transfer term PFC also enters the model's system of equations. While key household variables, such as the sequence $\left\{ \hat{k}_t, \hat{c}_{ij} \right\}_{t=0}^{t=\infty}$ are changed by the payments, the negative effects on urban households are just offset throughout the sequence by positive effects on rural households, as reported in the figures. This results because the households' preferences are identical and homothetic (although their consumption and expenditure levels vary) and no market failures are present. Thus, the sequence of key variables remains the same as in the base solution. The only affected variable is the price of land obtained from equation 14 (for more details see Roe et al., 2002)

The next experiment entails segregating agriculture's capital market from that of the rest of the economy. Effectively, this means that the non-land-owning urban households do not invest in agricultural capital $\hat{k}_a$ over the period of analysis. In addition to changes in household budget constraints, the market-clearing equation for capital and the Euler condition changed (for details, see Roe et al., 2002).

References

- Antonovitz, F., and T. Roe. "A Theoretical and Empirical Approach to the Value of Information in Risky Markets," *The Review of Economics and Statistics*. Vol. LXVIII, No. 1, February 1986. p.105-114.
- Barnard, C., R. Nehring, J. Ryan, R. Collender, and W. Quinby. "Higher Cropland Values from Farm Program Payments: Who Gains?" *Agricultural Outlook*. AGO-286. U.S. Department of Agriculture, Economic Research Service, November 2001.
- Barro, R., and X. Sala-I-Martin. *Economic Growth*. McGraw-Hill. 1995.
- Chau, N., and H. de Gorter. "Disentangling the Production and Export Consequences of Direct Farm Income Payments," Paper presented at the 2000 AAEA meetings, Tampa, Florida.
- Goodwin, B.K, A.K. Mishra, and F.N. Ortalo-Magne. "Differentiated Policy Impacts on Agricultural Land Values." Working Paper, Ohio State University. May 2002.

Goodwin, B.K, A.K. Mishra, and F.N. Ortalo-Magne. "What's Wrong with Our Models for Agricultural Land Values?" *American Journal of Agricultural Economics*, Vol. 85, No 3, August 2003a. p.744-752.

Goodwin, B.K, A.K. Mishra, and F.N. Ortalo-Magne. "Explaining Regional Difference in the Capitalization of Policy Benefits into Agricultural Land Values," in *Government Policy and Farmland Markets—The Maintenance of Farmer Wealth*, eds. C. Moss and A. Schmitz, Iowa State Press, 2003b.

Hirshleifer, D. "Risk, Futures Prices, and the Organization of Production in Commodity Markets," *Journal of Political Economy*. Vol. 96, No. 61, 1988. p.1,206-1,220.

Mas-Colell, A.M. Whinston, and J. Green, *Microeconomic Theory*. Oxford University Press, New York, 1995.

Orden, D., R. Paarlberg, and T. Roe. *Policy Reform in American Agriculture: Analysis and Prognosis*. Chicago. 1999.

Roe, T. "A Three Sector Growth Model With Three Assets and Sectoral Differences in TFP Growth," Economic Development Center Working Paper, Department of Economics and Department of Applied Economics, University of Minnesota. July 2001.

Roe, T., A. Somwaru, and X.Diao, "Do Direct Payments Have Intertemporal Effects On U.S. Agriculture?", Discussion Paper #104, <http://www.ifpri.org/divs/tmd/dp.htm> International Food Policy Research Institute, Washington, DC. October 2002.

Sandmo, A. "On the Theory of the Competitive Firm Under Price Uncertainty," *American Economic Review*. March 1971. p. 66-84.

Stiglitz, J.E. "Information and Economic Analysis: A Perspective," *The Economic Journal*, Vol.#95, 1985. p.21-41.

U.S. Department of Agriculture, Economic Research Service. *Decoupled Payments: Household Income Transfers in Contemporary U.S. Agriculture*. AER-822. February 2003.

Figure 1: Decoupled payments effects on land values are virtually unchanged by segmented capital markets

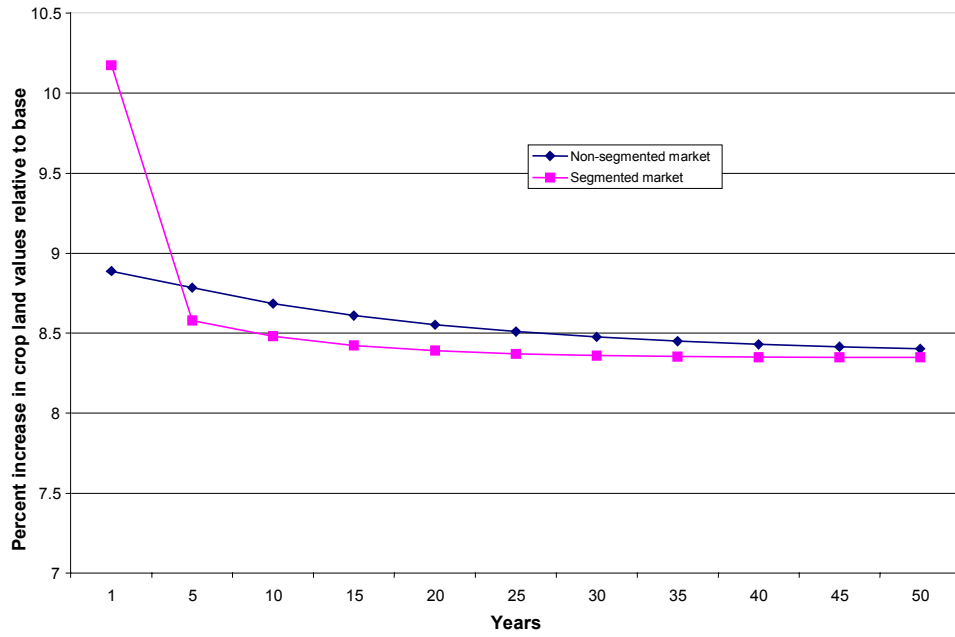


Figure 2: Decoupled payments increase assets and consumption expenditures

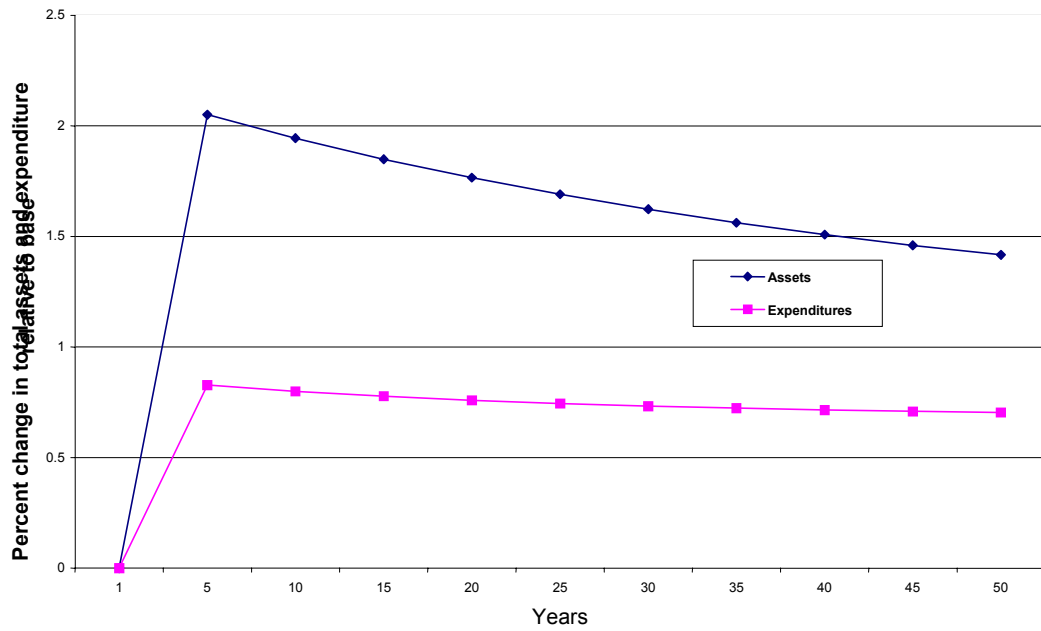


Figure 3: Decoupled payments have negligible effects on capital rental rates in agriculture: the segment case

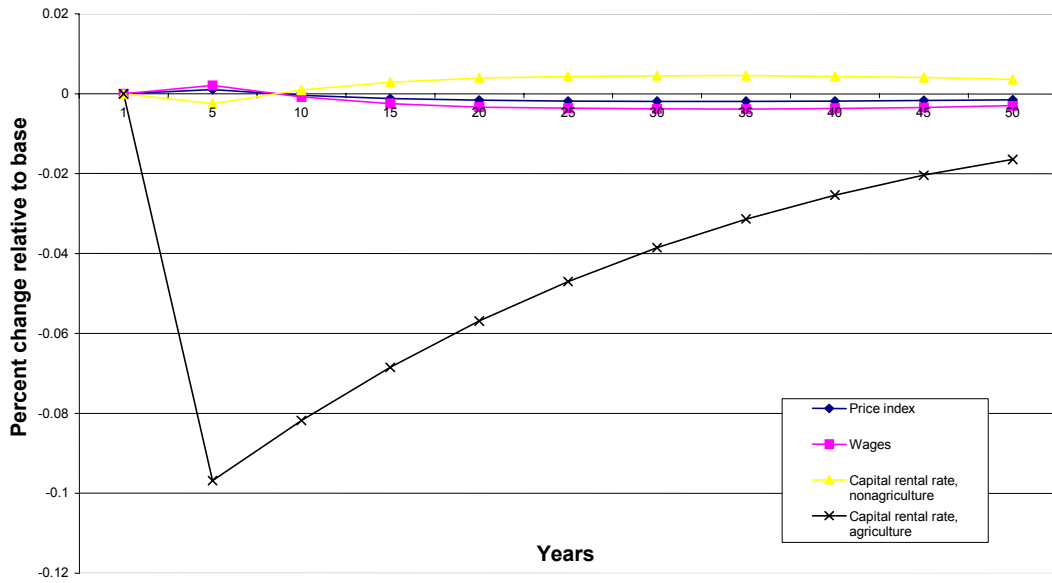


Figure 4: Decoupled payments have small effects on the stock of capital in agriculture: the segment case

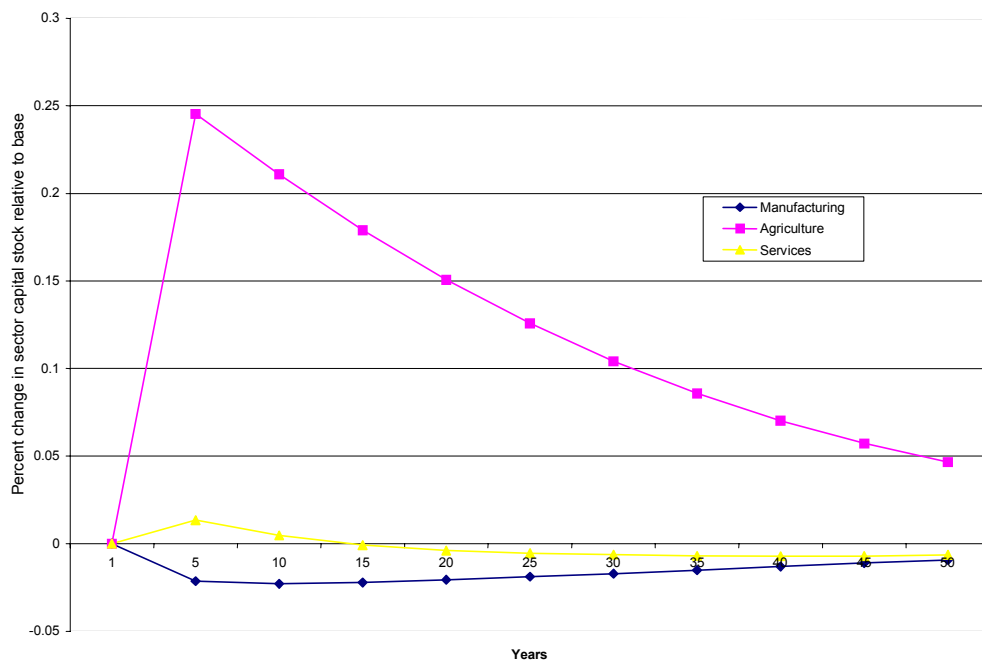


Figure 5: Decoupled payments cause a small increase in agricultural employment: the segment case
Percent change in sector labor demand relative to base

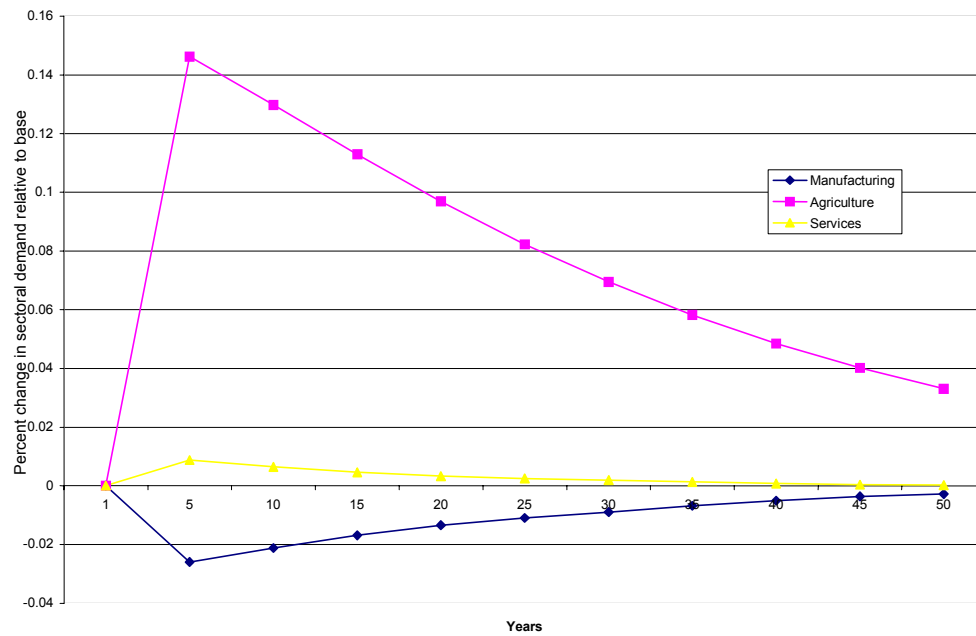


Figure 6: Decoupled payments induce a small short run increase in agricultural production and in the use of capital relative to labor: the segment case
Percent change relative to base

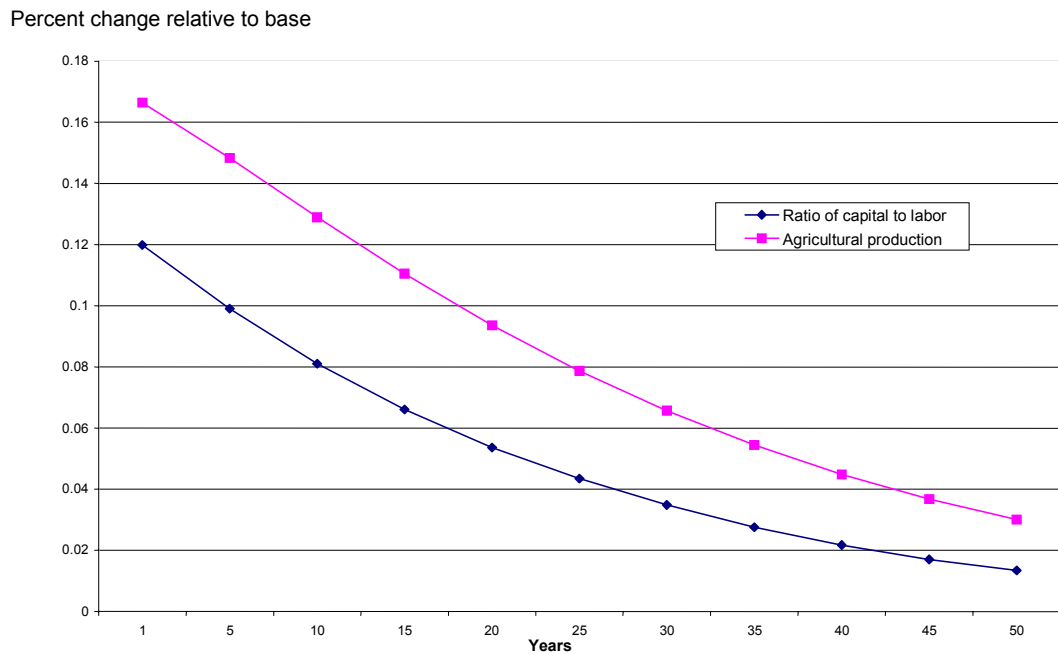


Figure 7: Decoupled payments have small and declining affects on output but lasting affects on land values and land rental rates: the segment case

