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Between the repeal of the British Corn Laws in 1846 and the outbreak of the First World War, world markets for many bulk commodities were transformed. Production increasingly occurred in regions far from the main consumers who received these commodities through long distance trade. Wheat was probably the product most affected. Vast continental areas in North and South America, Russia, Australia and even India changed from unsettled virgin prairie to wheat-growing areas while European farmers complained of growing imports and falling prices. Data on wheat production in various areas and its relationship to domestic utilization are presented in Table 1. The course of British wheat prices is illustrated in Figure 1.

There can be no question that world trade in wheat grew dramatically and that the European price fell in response to that expansion of supply. The economics of expanding supply, however, has been somewhat obscure. Wilfred Malenbaum, in his careful study of the world wheat economy, concluded that supply expansion was not the result of a price response in the new regions (Malenbaum, 1953, p. 109), and Franklin Fisher and Peter Temin (1970, p. 137) in detailed econometric analysis of American wheat production found "little evidence that total acreage had non-zero elasticity with respect to farm prices". Recent research (Harley, 1978), however, has demonstrated that these negative conclusions regarding the response of cultivated acreage to wheat price arose from incorrectly specified models that failed to take appropriate account of the changes in spatial distribution of wheat prices as transportation costs declined dramatically.

The demonstration that the expansion of production in new areas responded to price makes market analysis of settlement expansion and price

movements attractive. Such analysis indicates that both consumers and producers were responding in a stable manner to the prices they faced. The growth of trade and the changing location of production occurred in response to the combined impact of growing world population and falling transportation and distribution costs.

Producers in areas such as the American mid-west and the Plains expanded the area under cultivation in response to the price they received for wheat. This local price in turn was determined in international markets even when only a small proportion of production was exported. The role of international conditions as a factor leading to American expansion in the late nineteenth century is a hotly debated topic. The analysis presented here indicates that conclusions like that of Irving Kravis, (1972) who saw exports as relatively unimportant in American growth because export prices were not rising and exports were a small portion of output, may be misleading. Even with modest exports, prices were determined by world conditions. The analysis here indicates without growing world demand and transportation improvements, the price of wheat in the American west would have fallen dramatically and discouraged western expansion.[1]

I. Modelling the World Wheat Market 1850-1913

Declining transportation and distribution costs completely altered the wheat market in the late nineteenth century. The Gazette price of British wheat and the price of spring wheat in Chicago are plotted together of Figure 1. The near disappearance of the effect of distance on the price of wheat in exporting regions was not confined to the American mid-west (see

Table 2). Analysis of the world wheat market during this period must, therefore, explicitly consider this change in the effect of distance on price in various locations.

The changing spatial dimension of the market may be illustrated in a simple schematic way by Figure 2. Local price declined with distance from Liverpool, the principal importer and thus the high price market. The gradient, the effect of distance on price, became markedly flatter when transportation cost fell. When costs of production other than rent (which are drawn at a plausible level of 50¢ per bushel on Figure 2) are included the figure becomes a familiar Ricardian diagram of the determination of rents and extensive margin. With the 1850 Liverpool price and the prevailing distance gradient the extensive margin occurred just beyond Chicago; at 1913 Liverpool prices and distance gradients the extensive margin effectively ceased to exist.

The history of the world wheat market between 1850 and 1913 was not, however, simply a story of transportation costs. In terms of Figure 2, transportation costs determined the gradient of the local price line but the position of the line also changed. Investigation of this change involves a more complicated analysis of supply and demand which considers elasticities of response of producers and consumers and the effects of events that shifted supply and demand. Between 1850 and 1913, a rough doubling in world population was a particularly important demand shift.

The changes in the world wheat economy between 1850 and 1913 may be modelled in terms of a market with several regions in which both production and consumption occurred. Britain imported wheat from

all the exporting regions, so the price in each region, at least at equilibrium, differed from the Liverpool price by the cost of transportation to Britain. In the modelling exercise these transportation costs are assumed to have been characterized by constant costs and actual historical price differences have been used. These differences, of course, change over time and affect the market equilibrium.[2]

The supply and demand curves in each producing and consuming region relate quantity supplied and demanded to local price. Supply in the exporting regions where acreage was expanding has been estimated on the basis of the econometric results presented by Harley (1978, equation 4). The following results were presented for states in the American North Central Census region:

$$\Delta(\ln A) = -0.03 + 0.09 \ln Pr(\text{wheat}) + 0.04 \ln RR - 0.13 \ln A_{t-1} \quad (1)$$

where A is acreage harvested in cereal crops in each state relative to the 1913 acreage, Pr(wheat) is the price of wheat in the state in the three most recent years deflated by Simon Kuznets' implicit GNP deflator and RR, railroad mileage in the states relative to the 1913 mileage. This is a stock adjustment equation that implies an equilibrium acreage (relative to 1913) - A* - such that

$$\ln A^{*} = -0.2 + 0.7 \ln Pr(\text{wheat}) + 0.3 \ln RR. \quad (2)$$

Railway mileage appears as an important determinant of desired area. In the econometric estimation of settlement railroad mileage could reasonably be considered exogenous. Such an assumption, however, is inappropriate in an analysis of the world wheat market. Instead here railroad mileage and settlement are explicitly assumed to have been

jointly determined, at least in the long run. Consequently long-run equilibria have been calculated assuming that in long-run equilibrium there would be the same density of railroad per cultivated acre as prevailed in 1913. Estimated equilibrium wheat production in the American North Central Census region has been calculated by using state by state prices to calculate equilibrium acreage in each state (i.e., $A^* = .73\ Pr(wheat)$). The state by state acreage figures are summed to yield acreage for the entire region. Wheat production for the entire census region is assumed to be the same proportion of 1913 output as the estimated acreage.[3] This supply response estimated for the American West has been extended to other exporting areas. Consequently overseas supply of wheat is estimated as the same proportion of 1913 output as the estimated proportion of 1913 area to total equilibrium area under cultivation in the North Central Census Region of the United States.[4]

Clearly the coming of the railroads at mid-century altered the world wheat market, and may have been a decisive cause of change. An attempt must be made to model its impact. The supply response in the American west shows that railroad mileage significantly influenced settlement. Harley (1978) justifies the railroad variable in the regression results as a means of correcting observed state price to farm-gate price in various parts of the state. The more railroad miles in the state the closer the farm-gate price throughout the state will be to the prices in established areas from which price data were gathered. This occurs because potential grain production in various areas of the state would involve shorter costly wagon hauls when railroad mileage was extensive (p.). In the absence of

railroads, a canal network would have provided similar transportation services with similar effect. Constraints of water availability and topography, however, would undoubtedly have led to a lower transportation density if railroads had not been built. The exact nature of the difference is impossible to predict with any accuracy since the coming of railroads, in fact, led to the end of canal building in most areas. In the calculations presented below it is assumed that if railroads were unavailable, the supply response with canals could be approximated by equation 2 with a transportation network with only one third the density achieved with railroads in 1913.[5]

The supply of wheat in Britain and the eastern United States has been assumed to be stable throughout the period with an elasticity of approximately one. This estimate is based on studies by Olson and Harris, (1959) and Fisher and Temin, (1970). Estimating the supply response in Continental Europe presents greater problems. These areas responded to declining wheat prices by instituting tariff protection and did not contract production in the late nineteenth century (Kindleberger, 1951 and Malenbaum, 1953, Ch. VII). The analysis considers two alternatives. First it is assumed that tariffs equivalent to the actual average tariff of $0.30 per bushel that prevailed in 1913 would have been imposed when wheat prices fell and that the supply response to local price was stable with a unit elasticity.[6] Second tariffs to maintain output are considered.

Demand for wheat is clearly inelastic. Per capita consumption of wheat in various countries varied little in the pre-War period although there were important intercountry differences (Malenbaum, 1953, Ch. V). Jasny's (1940, pp. 84-93) conclusion that the price elasticity of demand was about 0.3 has been used to estimate demand response in

each area. In addition the demand curve in each region has been assumed to shift in proportion to population growth.[7]

These supply and demand characterizations combined with historical transportation costs and the market clearing condition that total world supply equal total world demand permit calculations to assess the impacts of transportation improvements and population growth--the only exogenous elements in the modelled market. Table 3 presents calculated prices and quantities for an 1850 market equilibrium using actual pre-War data as a base for calculation. The effects of transportation improvements and demand increases acting separately are also presented in the table. The 1850 equilibrium price calculated for Chicago is not inconsistent with observed prices in the early 1850's.

The increase in world wheat output between 1850 and 1913 can be attributed almost entirely to rising population. Because wheat demand had a low price elasticity, supply curve shifts had little impact on equilibrium output in the absence of demand curve shifts. Since income had little impact on demand, demand shifts arose from growing population. The impact of demand growth and transportation on the distribution of production and wheat prices in various locations is more complex. In the absence of transportation improvements expansion of settlement into regions like the American west would have continued but at a much more modest pace. If line 1 is compared with lines 4 and 6 it can be seen that only about half the expansion in the American west would have occurred without transportation improvements while production in the importing regions of the eastern United States and Europe would have been substantially greater than it actually was in 1913.

The impact of transportation on prices in various areas is perhaps somewhat more unexpected. Although transportation improvements raised the price in Chicago (in the exporting region) and lowered price in the importing regions, the price movement in the importing region was much greater than the price movement in the exporting region (compare lines 2 and 3 or 5 and 6). This result arises because a given change in the price of wheat had a greater impact on production in the exporting region than it had in the importing region. This different response to price changes arose from three factors which worked with different impacts at different parts of the period. First a given price change (say 10 cents per bushel) had a larger impact in the exporting region than in the importing region because it represented a larger percentage price change in the exporting region where price was low. Thus, although supply elasticities are all modelled as unitary to local price, with 1850 prices a price change of 10 cents a bushel was a 20 percent change of the Chicago price (and an even larger percentage change farther west) but only a 6 percent change in the British price. This effect was considerable early in the period when the price differentials were large. Second a given percentage change in price when all producers respond with the same elasticity results in larger absolute changes in output of the producers with the greater outputs. By the late 1870's the exporting regions supplied about 55 percent of the world's wheat and that proportion had increased to 70 percent by the war. This impact was increasing through the period. Finally a tariff in Continental Europe had the effect of severely curtailing the reduction in wheat supply by Continental farmers from consumption protected domestic markets (these farmers produced about a quarter of the world's wheat in 1913). In the absence of these tariffs, Continental price and production would have fallen

and both the output and the price of wheat elsewhere would have increased about 7 percent.

II. Expansion of a Staple Wheat-Producing Region: The American West

Between 1850 and 1913 the production of wheat in the North Central Census Region of the United States expanded from close to 45 million bushels to just over 500 million bushels. Expansion of output occurred primarily because equilibrium in the world market changed as world population grew and transport costs fell. Until the 1890's, however, the effect of long-run forces was obscured by complex processes of adjustment and by short-term disruptions of the market. Although world wheat prices in the early 1850's do not appear much different from long-run equilibrium, that equilibrium had not yet been attained. Long-run equilibrium required an expansion of production in exporting regions and a reduction in the importing region. For example production in the American mid-west would have increased by about 150 percent and production in Britain fallen by 20 percent. The introduction of the railroads increased the existing disequilibrium in the 1850's by making more areas attractive at the prevailing price of wheat. In addition price was driven further above its long-run equilibrium by cessation of Russian exports during the Crimean War.

Many observers (see for example Malenbaum, 1953, pp. 108-110 and Kravis, 1972, pp. 390-392) of the world economy have been misled to the conclusion that world conditions were of relatively little importance in American expansion because there was not a clear upward trend in export prices. Figure 3, where the price of wheat in Chicago deflated by Kuznets' GNP deflator is presented for the period from 1850 to 1913, confirms the usual observation that there was not a dominant upward trend in price, even in the producing region. Examination of the determinants

of expanding cultivation in various western states utilizing the data and conclusion embodied in equation 2 further confirms the observation that a rising local price was not the driving force of expansion. Data on cultivated area, wheat price and equilibrium area calculated from equation 2 for Indiana--one of the more easterly states of the North Central Census Region--and Nebraska--one of the more westerly states are presented in Figure 4. The increase in cultivated area is seen as the result of a combination of movement to the equilibrium level of cultivation and a movement of that equilibrium. The trend movement of the equilibrium area that is important in more westerly states occurred, however, not as a result of a rising trend in prices, as might be expected from our analysis of the world wheat market, but rather as a result of railroad construction.

Even though rising local price was not the major cause of farmers' response, it would be unwarranted to dismiss the role of expanding demand for agricultural products in new regions as a principal factor in expansion of cultivation. The interaction of supply with demand changes arising from growing world population and the effects of changing transportation and distribution costs was more complex than the simple model most observers appear to have had in mind. During the half century following the repeal of the Corn Laws the short-run equilibrium that determined prices was often far from long-run equilibrium. Long-run supply response involved complex adjustments within the world economy. In particular the settlement of the wheat producing regions in the interiors of the world's continents involved railroad construction, international capital movement and the migration

of people on a scale without historic precedent. Such adjustments were obviously far from instantaneous. Consequently long-run disequilibrium persisted for long periods. Slow adjustment to long-run supply equilibrium was not the only reason prices remained high and above long-run equilibrium. Equally important transportation improvements and growing population were also rapidly increasing the demand for wheat from the exporting regions. Even though supply was expanding rapidly price remained above long-run equilibrium because demand was also growing rapidly.

The market process may be illustrated by Figure 5. From a short-run equilibrium such as that formed by the intersection of the S^{SR}_{1870} and D_{1870}, supply expanded because price exceeded long-run supply price, to S^{SR}_{1880}. In the absence of demand increase price would have fallen as a result of this supply adjustment to long-run equilibrium. In fact, however, demand increased to D_{1880} in response to population growth and transportation improvements. Thus price decline was prevented.

The fact that the real wheat prices in Chicago fluctuated around an approximately constant price of just under $1.00 a bushel, as indicated in Figure 3, implies that on average short-run supply and demand, viewed from the vantage point of the exporting region, were growing at the same rate. Demand, viewed from an exporting location like Chicago, was the world demand at any particular Chicago prices (and corresponding prices elsewhere) less supply in the importing regions at those same prices. The available data can be used to trace the shift of this demand between, say, 1850 and 1890--the period of movement to long-run equilibrium in the wheat market. In 1850, trade in wheat was of very minor importance in the world economy and the exporting regions produced for their own consumption. Between 1850 and 1890 world

population grew, transport costs fell and trade assumed central importance. The rapidly falling transport costs led to falling prices in the importing regions of the eastern United States and Europe. These regions responded either by reducing wheat production or by imposing tariffs to prevent the decline of domestic agriculture. In any case, the incentives in the importing regions were not to increase production and so all the growth in demand was directed to the exporting regions. The main demand growth arose from growing world population, since, other things being equal, demand growth would be proportional to population growth. World population, weighted by per capita consumption, grew from just under 50 percent of its pre-war level in 1850 to just over 80 percent of its pre-war level in 1890 (see Appendix Table). In 1850, therefore, demand was approximately half of its pre-war level while production in the exporting regions equalled about 15 percent of total pre-war output. The increase in population, therefore, implied a growth of demand for exporters' wheat at a rate of nearly three percent per year. This somewhat underestimates total demand growth in the exporting region since a given price in, say Chicago, represented a considerably lower price in the importing region in 1890 than it had in 1850. A price of $1.00 a bushel in Chicago in 1850 implied a Liverpool price of $1.95, while in 1890 a dollar a bushel in Chicago implied a Liverpool price of $1.20. As a result the demand for wheat at a given Chicago price grew more rapidly than indicated by population growth alone. This effect, however, was of minor importance both because of the price inelasticity of demand and the institution of Continental protection.[8]

Supply expanded in the exporting regions, on average, at about the same rate as demand grew. The most rapid expansion occurred in the American West where wheat production recorded in the Census increased from 45 million bushels in 1849 to 320 million bushels in 1889. This is a growth rate of nearly five percent per year. Expansion of supply from other exporters was less rapid. In particular, Russia, which provided over forty percent of the wheat in long-distance trade in the 1850's and 1860's (Harley, 1975, Table 4) expanded wheat output significantly less rapidly than did the American West. Raymond Goldsmith's estimate of grain production in Tsarist Russia shows a growth rate of about two percent per year between 1860 and 1890 (1961, p. 46).

The existence and persistence of prices above their long-run equilibrium level is documented in the data on the settlement process for representative American Western states that are presented in Figure 4. The equilibrium areas indicated in the figure are calculated from equation 2 and show the area that would have been cultivated if the actual price of wheat and railroad mileage had remained unchanged while settlement expanded to take advantage of all favorable opportunities at that price. Final equilibrium area exceeded actual supply by a considerable margin until the 1890's. These data presented for Indiana and Nebraska are representative of the other wheat-producing states of the U.S. and presumably, approximately at least, of the exporters as well. In the 1870's the prevailing Chicago price of about a dollar a bushel (1913 prices) would have generated long-run equilibrium supply from the American North Central Census Region about twice the actual output of the area in the 1870's. This expansion of American production would have increased world output by more than 15 percent. If the other exporters

responded in a similar manner the increase in output would have been about three times as great as the American expansion alone. This excess long-run supply at prevailing prices equal to about half world consumption makes it clear that the prices in the 1870's were above long-run equilibria. The prevailing short-run equilibrium price would have been subject to intense downward pressure as cultivation in the continental areas expanded in response to the prevailing prices.

It is possible to utilize the model of world long-run equilibrium developed in Part I above to elaborate this point and trace movement toward equilibrium. Long-run equilibria have been calculated for various years and are presented in Table 4. These equilibrium prices are compared with actual wheat prices in Chicago deflated by Kuznets' deflator in Figure 3. The actual price remained above equilibrium until the 1890's; between 1850 and 1890 the level of wheat prices provided incentive to expand cultivation into new areas. Consequently there was potential downward pressure on price. Expanding demand and falling transport costs, in fact, did not drive up the American price of the export staple but rather prevented its fall to long-run equilibrium. Only in the 1890's, when equilibrium price had risen to near the average price of the past decades, did the market approach equilibrium.[9]

Expansion of settlement in the new areas occurred not because wheat prices were rising but because prices remained high enough to make the settlement of new areas attractive. When we compare the 1913 output with the 1850 output we find that expansion was almost entirely due to changing world conditions. In 1850 the actual output of the American West appears to have been below equilibrium. Adjustment to the 1850 equilibrium, without railroads, would have increased output from the approximately 45 million bushels reported

in the 1850 census to 125 million bushels. The rest of the expansion arose from the growth of world population and transportation improvements analyzed in Table 3.

The innovation in transportation that the coming of the railroads represented, shifted supply by increasing farm-gate prices in parts of the various states where the use of canals would have involved long wagon hauls relative to the price at interregional shipment points.[10] The overall impact of the railroads on western expansion in the absence of population growth and transport cost reduction would have been modest (compare lines 1 and 2 or 4 and 5 in Table 3). The greatest impact of this supply expansion would have been a reduction in world price. Wheat production in the American West would have expanded relatively modestly. This result, of course, arises from the inelasticity of demand for wheat.

The fall in transport costs had greater impact than the incentive to increased production provided by railroads replacing canals. Acting alone the near disappearance of the effect of location on prices would have increased equilibrium output in the American West from about 150 million bushels to about 250 million bushels (compare lines 2 and 3). Again the impact is modest because of inelastic world demand. The increase in output in the staple-exporting regions in this case is almost offset by a decline in output in the importing region. Much of this reduction in output is postulated to have come from Continental Europe since the tariff level hypothesized equals that in force in 1913. If the alternative assumption that European governments would have adopted tariff policy to inhibit the reduction of wheat output is considered, wheat prices outside the protected European markets would have been even lower and the expansion in the exporting regions would have been nearly eliminated (see note a in Table 3).

These discussions of the effects of transportation improvements without growing world demand serve to emphasize the importance of the growth of world population on the expansion of the primary exporting regions during the late nineteenth century. Population growth alone would have raised the 1850 equilibrium level of output by 168 percent (compare lines 1 and 4 in Table 3). In addition the impact of transportation improvements on expansion of cultivation were greatly enhanced when combined with population growth (compare the difference between lines 1 and 3 with the difference between 4 and 6). This contrast assumes a Continental tariff of 30 cents a bushel and would, of course, have been even more marked if it is assumed Continental tariffs that would have preserved output if prices fell (compare the result in the note a to the table).

The crucial importance of international demand conditions for the expansion of wheat-producing regions emerges as an inescapable conclusion of the preceding exercises. To be sure, the calculations presented in Tables 3 and 4 are subject to a wide range of error and no particular number can be more than indicative of possible equilibria if only some of the actual historical changes had occurred. Nonetheless there can be no substantial objection to the general results since their qualitative nature arise as implications of very reasonable general assumptions about supply and demand behavior.

The history of the expansion of settlement into staple grain-producing areas clearly involved the entire world market. The price of wheat was the key incentive to agricultural expansion and that price was determined internationally. Thus even though only about 15 percent of U.S. wheat was exported in the years just before the war, the

expansion of settlement into the west was primarily the result of developments in the world market. There has, however, been a tendency to overlook this fact because the expansion of world demand and falling transport cost did not stimulate expansion through rising prices but rather by preventing prices, driven up by short-run influences, from falling as settlement expanded supply in the exporting regions. Without growing world population and falling transportation costs, wheat prices would have fallen so low as to discourage settlement of the Plains. Growth of American population alone was not sufficient to stimulate western expansion since local wheat prices would have been so low as to make much of the west unattractive. If only American population had grown some of the wheat consumed in the industrial areas of the United States would have come from Russia and India.[11]

III. Conclusion

Wheat production and trade in the world was substantially altered by the combined effects of growing population and falling transport and distribution costs between 1850 and 1913. The importing areas benefitted from falling prices and the ability to import large quantities from overseas producing areas. Transportation improvements meant that substantially increased demand could be satisfied at substantially lower prices.

The settlement of continental areas of staple wheat production was dependent on both growing world demand and falling transport cost. On balance the growing demand accompanying increasing world population had the greater impact. In the absence of this growing demand most of the impact of transport improvements would have taken the form of lower wheat prices and would have had only modest impact on settlements of new areas. This would have been especially true if Continental European governments

had pursued policies to prevent the rapid contraction of their agricultural sectors. Thus, even though the actual historic trend of price in areas like the American west was not upward, growing world demand was a key to expansion. Without that growing demand the price of wheat would have fallen rapidly from the peak prices of the mid-1850's and stifled expansion of settlement.

Appendix: Data used in Equilibrium Calculations

1. Price Differentials from Liverpool (1910 cents)

	1850	1870	1890	1910
New York	-30	-20	-5	-3
Chicago	-95	-50	-20	-5
Europe	0	0	+30	+30

(Also see Table 4 for differentials in U.S. west.)

2. Population and Per Capita Consumption of Wheat

	Population (millions)				Per Capita Consumption
	1850	1870	1890	1910	1913
Exporters:					
U.S. West	10	20	44	54	5.0 bu.
E. Europe	55	85	120	160	4.5
India	175	225	285	303	.75
Others	6	7	11	19	5.0
Importers:					
U.S. East	13	18	25	38	5.0
Britain	22	29	36	42	5.5
W. Europe	130	158	188	200	5.0

Footnotes

[1]Although the analysis presented here indicates that world market conditions were important in American westward expansion and suggest they may have been a more important factor in the long swings in growth than some authorities have argued, this argument cannot be extended to the growth of per capita income. I am convinced this was a different process.

[2]For a discussion of the changing price differentials between localities which, in fact involved distribution costs as well as freight rates, see Harley, 1975.

[3]Wheat production is estimated on the basis of the entire census region because the distribution of wheat by state changed over time as the Corn Belt shifted away from wheat and concentrated on animal production. If wheat production were calculated for each state as the same proportion of 1913 output as the estimated 1913 cultivated area, the calculated output would be unreasonably small in early years when settlement had not extended to the Plains.

[4]This calculation is obviously a somewhat crude approximation. It seems a reasonably appropriate procedure for other areas of recent settlement but may be somewhat heroic when applied to Russia and the other Black Sea exporters and to India. For example, Russia and the other Black Sea exporters produced some twenty percent of the world's wheat, but data on these producers are practically non-existent. Even population is largely unknown; the only pre-First World War census of the Russian Empire occurred in 1897 (Glass and Grebenik, 1965, pp. 62-3). The expedient of using the American response to estimate Russian response is obviously imperfect. Much of

the grain marketed in Russia appears to have been sold by peasants to meet tax and redemption obligations. To the extent that grain was sold only to meet these commitments, the supply response to price movements would obviously be different than that in the American west. At least the Odessa price of wheat corresponded quite closely to the Chicago price throughout the period (Harley, 1975, Appendix Table) and the expansion of output involved the expansion of cultivation into frontier areas.

If these areas are assumed not to have responded to price as did the American west but rather expanded output for some exogenous reason, the conclusion about the importance world demand increased American production is greatly reinforced. If supply had expanded exogenously and demand not shifted price would have fallen extremely dramatically discouraging American expansion.

[5]This is an essentially arbitrary procedure. By 1860 just under 1,000 miles of canals had been built in Ohio. It is hard to imagine much of an increase in the figure. In contrast there were about 3,500 miles of railroad in Ohio in 1870, nearly 6,000 in 1880 and nearly 8,000 in 1890. This adjustment assumes output without railroads at a given price would be just under two thirds the output with railroads.

It is appropriate to assume that the introduction of railroads in 1850 did not affect the interregional distribution of prices. Fogel (1964, pp. 38-48) finds little difference between rail and water rates in interregional trade as late as 1890. Most of the grain crops of the North Central Region continued to move east via the Great Lakes for at least a quarter century after 1850.

[6]A lower supply elasticity would imply a higher equilibrium price with 1913 population and 1850 price differentials (see note b to Table 3) and also lower prices if transportation improvements had occurred without population growth.

[7]It is probably true that population growth in various areas was, at least partially, influenced by the growth of long distance trade in foodstuffs and other primary products. This seems particularly true where emigration was important. This effect has not been incorporated into this analysis.

No income elasticity has been incorporated. If income were important to demand and growing independent of developments in the wheat market the 1850 equilibrium price would have been below that presented in Table 3.

[8]The decline in European wheat prices associated with a stable Chicago price of $1.00 per bushel is 1.2% per year. If this entire decline had been allowed to occur demand in these areas would have increased at 0.36% per year and production (at a unit elasticity of supply) declined by 1.2% per year. Since about half world consumption and about 40% of production occurred in the importing areas this effect would have increased demand at a given Chicago price by an additional 0.64%. Of course, most of this did not occur because Continental prices were maintained by protective tariffs and output in these countries did not decline.

[9] Long-run adjustment was clearly not the only determinant of prices between 1850 and 1890. In particular there were significant short-run peaks caused by temporary disruptions in the market and uneven adjustment. The price peak in the 1850's corresponded to the Crimean War which cut off exports from Southern Russia. In the 1860's successive bad European harvests in 1866 and 1867 drove up prices. The 1880's were characterized by relatively slow expansion in Russia and a dramatic shift to animal production in the American Corn Belt, at the same time that transportation cost declines insulated farmers on the Great Plains from falling European prices.

[10] The increased transport density with railroads would have increased output by sixty percent at any given price.

[11] The fact that a principal effect of foreign markets on the U.S. economy during the late nineteenth century was to prevent agricultural prices from falling even though only a small proportion of the industry's output was exported calls into question such literature as Irving Kravis' (1972) analysis of the role of the international market in American growth, which depends on growing exports. Also Richard Easterlin's (1968, p. 34) conclusion that the long-swings in American growth caused the changes in agricultural prosperity fails to appreciate the fact that most agricultural prices were determined in a world market where changes in American conditions had modest impact.

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Table 1

Wheat Production and its Relationship to Utilization
Various Areas, 1875/9 and 1910/13

	1875/9		1910/13	
	Production (mn. bu.)	Production/ Utilization	Production (mn. bu.)	Production/ Utilization
Principal Importing Regions				
Britain	80	0.41	56	0.23
Eastern United States	63	0.50	56	0.27
Belgium, Holland, Denmark	25	0.49	27	0.29
Germany	110	0.90	169	0.71
Italy	140	0.99	176	0.76
France	261	0.92	309	0.87
Austria - Hungary	98	0.95	231	0.96
Total Importers	777		1024	
Principal Exporting Regions				
United States				
East North Central	205	2.30	121	1.07
West North Central	125	2.50	384	3.28
Russia	304	1.15	800	1.22
Danutian States	40	1.31	152	1.89
Canada	24	1.00	208	2.00
India	224	1.04	368	1.18
Argentina	24	1.20	96	2.22
Australia	80	1.00	152	2.60
Total Exporters	1026		2281	

Source: Harley, 1975, Table 5. Regional utilization in the United States is estimated on the basis of 14.5% feed and seed use and per capita food consumption of 5.25 bushels.

Table 2

Price of Wheat in Various Markets, 1861-1913

(gold cents per bushel)

	1861/5	1901/05	1909/13
Britain (Gazette)	141	85	100
Chicago (Spring)	71	83	100
Odessa	91	77	
Calcutta (Club)	95	76	93

Sources: Britain, Chicago and Odessa: Harley 1975, Appendix Table 1.

Calcutta: Index Numbers of Indian Prices 1861-1931 (Department of Commercial Intelligence and Statistics India, Delhi 1933).

Table 3

Analysis of Change in the World Wheat Market, 1850-1910

	Prices (1910 prices)			Quantity (1910 = 100)	
	Chicago	New York	Britain	World	U.S. West
1. 1850: No railroads, long-run equilibrium	$0.55	$1.20	$1.50	50	25
2. 1850: Railroads, but no change in geographic price distribution	0.35	1.00	1.30	50	30
3. 1850 population: 1913 geographic price distribution[a]	0.50	0.52	0.55	54	50
4. 1913 population, no railroads; 1850 geographic price distribution[b]	1.10	1.75	2.05	91	67
5. 1913 population, railroads; 1850 geographic price distribution	0.90	1.55	1.85	95	77
6. 1913 actual	0.95	0.97	1.00	100	100

Notes: a. If calculation 3 assumes that European tariffs were designed to prevent output fall rather than were at the actual 1913 level: Pr (Chicago) = 0.40, Q world = 57, Q U. S. west = 40.

b. If the elasticity of European supply in calculation 4 is assumed to be 0.3 instead of 1.0: Pr (Chicago) = 1.25, Q world = 90, Q U.S. west = 79.

Source: see text.

Table 4

Long-Run Equilibrium and Observed Prices and Quantities
American West 1850-1910

	Prices (1913 dollars)				Wheat Output North Central Census Region (% of 1910)	
	Chicago		Liverpool			
	Actual	Equilibrium	Actual	Equilibrium	Actual	Equilibrium
1850[a]	$0.55	$0.35	$1.50	$1.30	8	25
1870	0.90	0.60	1.40	1.10	40	50
1890	1.00	0.80	1.20	1.00	65	80
1910	0.95	0.95	1.00	1.00	100	100

Equilibrium Values, Selected States

	Indiana		Iowa		Nebraska	
	Price	Q	Price	Q	Price	Q
1850	$0.35	45	$0.16	20	$0.10	10
1870	0.55	65	0.40	50	0.33	40
1890	0.75	90	0.65	80	0.60	75
1910	0.95	100	0.85	100	0.80	100

Note: a. Assumes railroad building.

Sources: 1. See text for equilibrium values.
2. Price data: Harley 1975.
3. Quantity data: U.S. Censuses.

FIGURE 1

Wheat Prices: Chicago and Britain

1850-1913

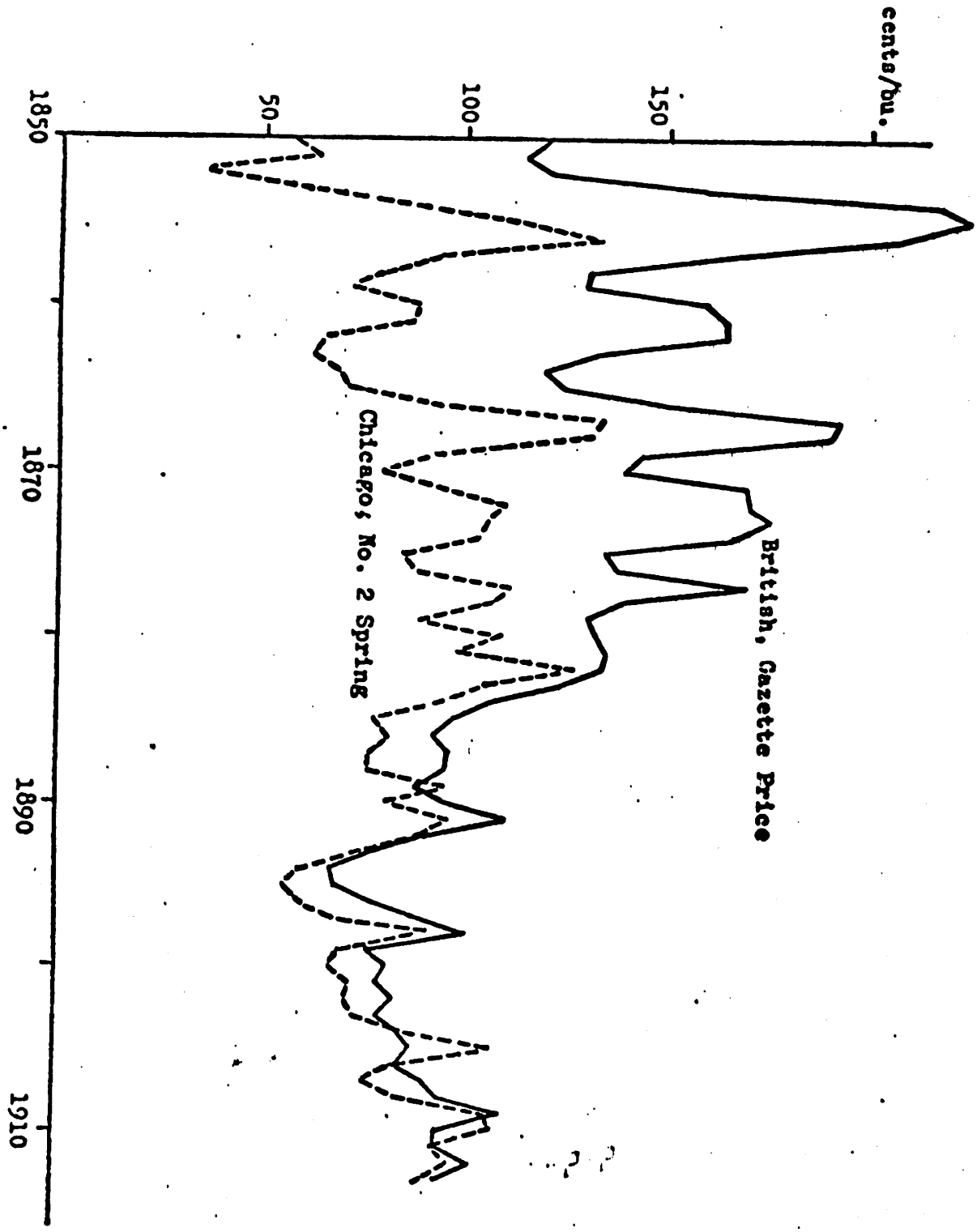

FIGURE 2

Price-Distance Relationships, 1850 and 1913

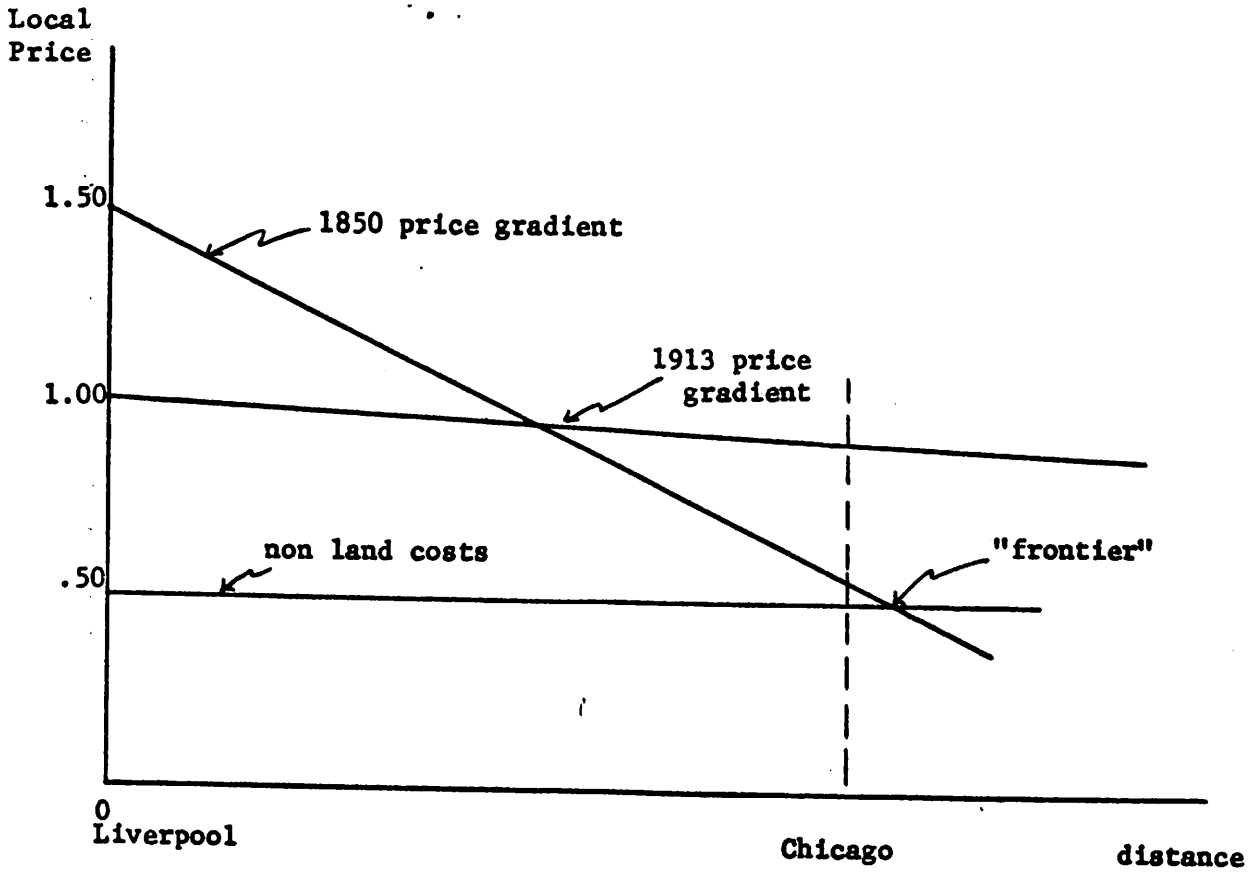

Figure 3

Deflated Chicago Wheat Price and Estimated Long-run Equilibrium Price, 1850-1913

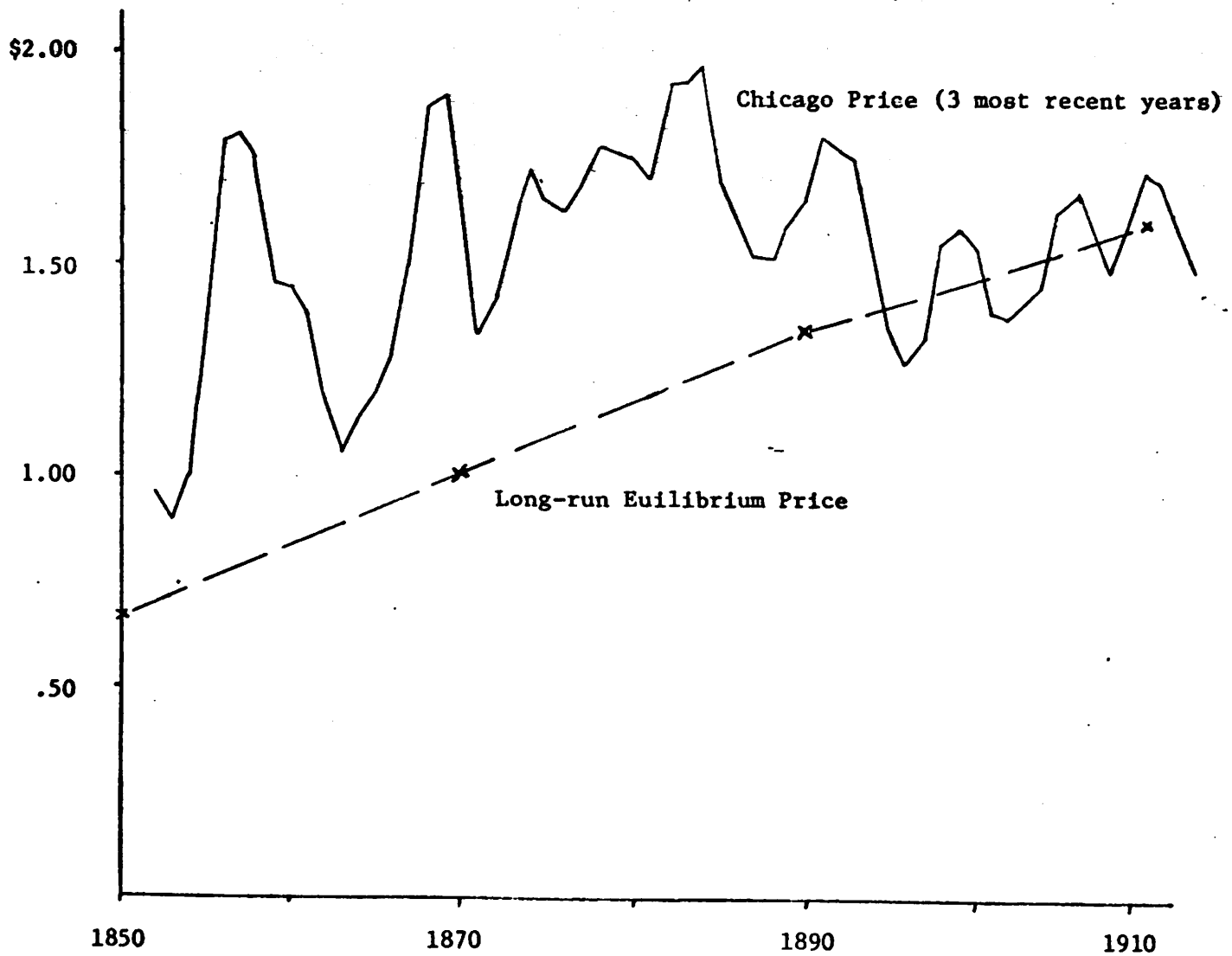

Figure 4

Cultivated Area, Equilibrium Area, and Real Farm Price

By States, 1867-1913

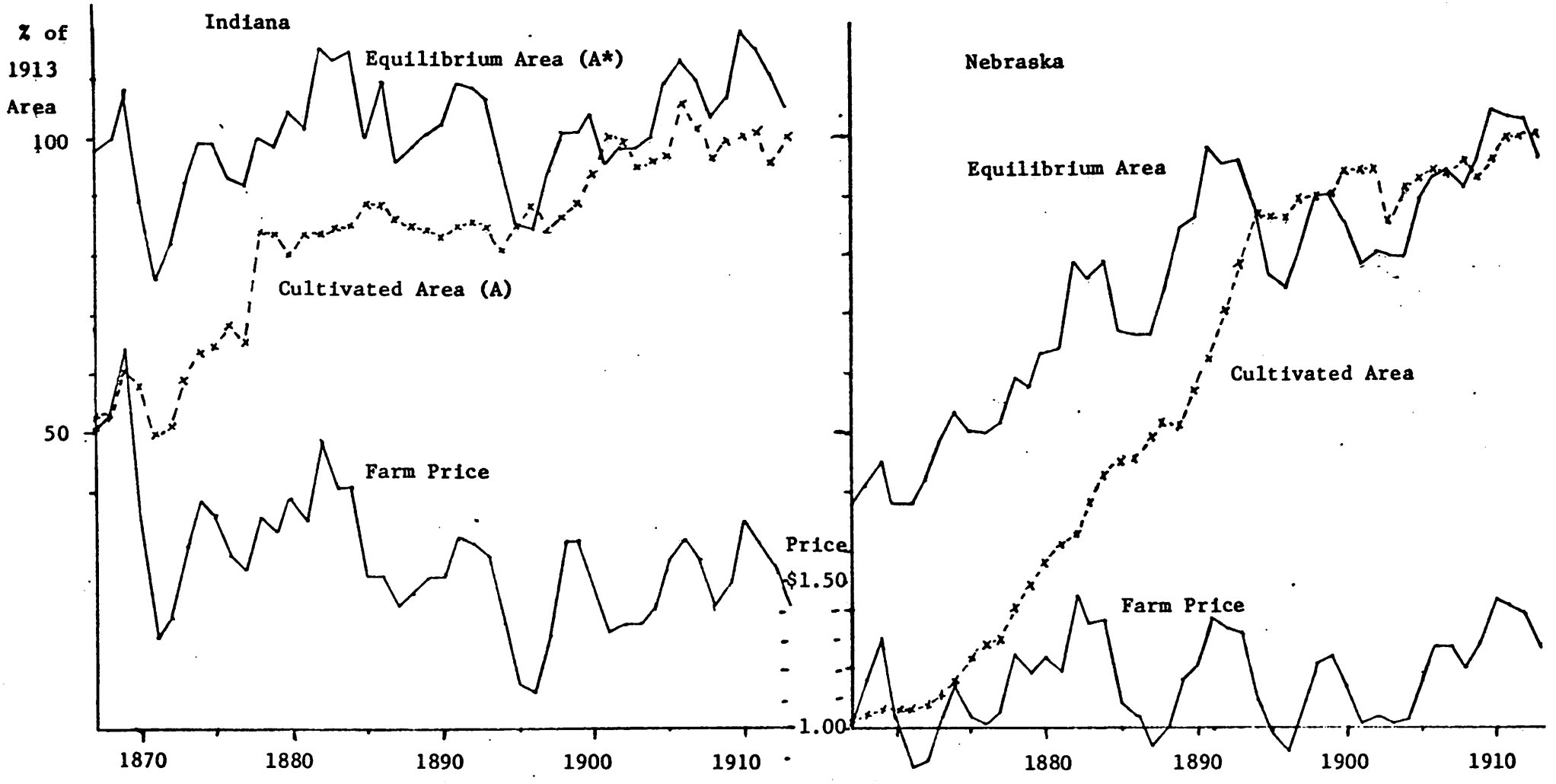

Figure 5

Moving Short-run Equilibrium and Long-run Supply