ISSN 1471-0498



DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

STRUCTURAL CHANGE IN ARGENTINA, 1900-1973: THE ROLE OF IMPORT SUSTITUTION AND FACTOR ENDOWMENTS

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Number 437
May 2009

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Structural Change in Argentina, 1900-1973: The Role of Import Substitution and Factor Endowments

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May 26, 2009

Abstract

This paper investigates structural change in Argentina between 1900 and 1973. It has been argued that trade policy under import-substituting industrialization disfavoured agriculture and led to a "technological lag" in the sector, and that this explains agriculture's relative decline during a period of rapid industrialization. I find that there is no technological lag to be found in the data and, moreover, that relative prices had no discernible effect on agricultural output. A three-by-three model based on these findings is developed in which structural change is caused by exogenous changes in factor endowments. A simulation of the model replicates the observed structural changes from the 1920s onwards, suggesting that the decline of agriculture and rise of manufacturing can be explained by population growth once the land frontier had been reached.

Key words: Argentina, Economic growth, Structural change, Trade policy

JEL Classification: N56, O13, O14, O24, O41, O54

1 Introduction

The process of economic growth is rarely uniform: as an economy gets richer, so its structure also changes. In Argentina, much of the national economic debate over the twentieth century has concerned the causes and desirability of structural change, as the country industrialized and the traditionally-dominant agricultural sector declined in relative importance. This paper formalizes one strand of this long-standing debate in an attempt to answer the question: what was the underlying cause of structural change in Argentina from the Belle Epoque to the end of import-substituting industrialization (ISI)?

The rise of manufacturing has exercised Argentine economists at least since Bunge's (1920) discussion of the implications of the closing of the land frontier. Bunge argued that the high wages produced by the rural sector made manufacturing uncompetitive, and that high import tariffs were therefore required to protect it. But the formulation of trade policy inevitably involves conflict between exporting and import-competing sectors of the economy. As O'Donnell (1978) has famously argued, in Argentina the pendular swing of power between these groups fed back to economic outcomes in the form of the stop-go economy. Indeed, the conflict over trade policy continues to the present day, as demonstrations by the rural sector and its supporters against a rise in export taxes shook the Argentine government in mid-2008.

In his classis classic analysis of the Argentine economy, Díaz Alejandro (1970) argues that the trade policies of ISI, by reducing the relative price of agricultural goods, deterred production and investment in the sector. After blaming "exogenous factors" (p. 205) for the slowdown in agriculture over 1930-45 he states that "during 1945-55, domestic policies depressed the outlook for rural activities producing exportables" (p. 206). Moreover, in his view the government neglected technical change in agriculture. The legacy of the lack of investment by both the discouraged private sector and the irresponsible public sector continued to be felt up to the 1960s, he argues, and "the technological lag, in brief, may be taken as the most

stubborn culprit for post-1945 rural stagnation" (p. 206).

The essence of Díaz Alejandro's argument, then, is that government policy, including trade policies that affected relative prices, led to a low rate of productivity growth - a "technological lag" - in agriculture. Structural change on this view is thus due to different rates of productivity growth across sectors. Formal models of such structural change have been presented in the economics literature, starting with a celebrated paper by Baumol (1967). He argued that the sectors of the economy with the lowest rates of technical progress would represent a rising share of employment over time, and Baumol, Blackman and Wolff (1985) considered the application of the model to the US economy. More recently, Ngai and Pissarides (2007) develop the argument with a model of structural change with differentiated products and endogenous savings, similarly assuming different rates of technical progress in different sectors.[1]

I test Díaz Alejandro's argument from different rates of productivity growth using output and employment data. I find that productivity growth did not in fact vary substantially across sectors, contradicting Díaz Alejandro's explanation. Moreover, I find no short-run relationship between relative agricultural prices and agricultural output.

The finding that relative prices do not affect output is counter-intuitive. But since it is in the data, I present a simple model of the economy in which it is only changes in factor endowments, and not relative prices, that drive structural change. This follows Di Tella's (1970) emphasis on the importance of the closing of the land frontier in the process of industrialization. Di Tella argues that "the growth of the population exceeded the 'growth' of the stock of exploited land, and therefore the possibility of excess labour appeared... the employment capacity of industry was considered one of its main justifications from the beginning of its development" (p. 440).

[1] Ngai and Pissarides (2007), like Meckl (1999), also include a further mechanism that generates structural change between an investment sector and consumption sectors, on the basis of intertemporal utility maximisation. In this paper I ignore the production of investment goods. This is more realistic for developing countries like Argentina, which import most investment goods.

In the spirit of Bunge and Di Tella, the model formalizes the argument that the rapid rise in manufacturing and the relative decline of agriculture was driven primarily by changing factor endowments. I thus develop a three-by-three model based on standard competitive trade theory in which technical change is assumed to be uniform across sectors. Changes in the structure of output and employment are induced by changes in relative factor endowments, following the Rybczynski theorem. The use of three sectors and three factors allows considerably more flexibility than two-by-two Heckscher-Ohlin theory, but also requires simplifying assumptions to keep the analysis tractable. While trade theory has been used to analyze long run factor price movements (e.g. O'Rourke and Williamson 1994, 2002) it has not before, as far as I am aware, been used to explain changes in the structure of output. A calibration of the model fits the data well, suggesting that the observed structural change can be accounted for by changing factor endowments, and not relative prices.

Both of these explanations for structural change are on the supply side, but the literature on structural change also includes a third mechanism based on relative demand. Echevarria (1997), Kongsamut et al. (1997, 2001) and Meckl (1999) model structural change as the result of non-homothetic preferences. This explanation is based on Engel's Law, according to which people spend a declining share of their incomes on food (and hence agricultural produce) as their incomes rise. These models are not, however, applicable to open economies in which food is tradable, as agricultural output in such cases is not constrained by domestic demand. Moreover, they cannot explain the case of Argentina because agricultural output grew more slowly than the total population.[2] While a declining *share* of expenditure on food can be explained by plausible non-homothetic preferences, declining *absolute* consumption per capita cannot be.

Finally, structural change also occurs in dual economy models, in which there is

[2]From 1935 to 1973 the total population grew by 93 percent while agricultural output grew by only 50 percent. Note that I use "agriculture" to refer to both agriculture strictly speaking, and livestock-based products such as meat and hides. See Appendix for discussion of data and sources.

a 'traditional' agricultural sector and a 'modern' manufacturing sector. Following Lewis (1954), a large literature explores the implications of limits to factor mobility between sectors, and different market conditions across sectors; Temple (2005) provides a discussion of recent developments in this field. These models are not applicable to countries in which labour enjoys free mobility between sectors, and again are not appropriate for Argentina. Argentina's agricultural sector has been based on large scale units, and was not 'traditional' in the usual sense, since the late nineteenth century. Moreover, unlike in dual economy models, there has always been substantial labour mobility in Argentina. Indeed, as I discuss later, Argentine agriculture grew by attracting immigrants from abroad, who would only reach the countryside after passing through the port and urban centre of Buenos Aires.

While the present paper addresses relative growth rates of different sectors within the Argentine economy, a further debate exists over the causes of Argentina's general decline over the twentieth century relative to the leading economies. Di Tella and Platt (1986) argue that Argentina's slow growth after the closing of the land frontier was due to its failure to move from a rent-based economy to an economy based on "industry of the Schumpeterian kind, continuously introducing new technologies, new products, and new cost-reducing procedures" (di Tella and Platt 1986: 124). Díaz-Alejandro (1970) argues that poorly designed tariff structures led to high relative prices of capital goods, lowering real investment. On the other hand, Taylor (1992) argues that investment was constrained by a low supply of savings, itself caused by a high dependency ratio. These arguments help to explain low productivity growth in the economy as a whole, but do not concern the different rates of growth observed across sectors.

The analysis presented in the paper does, however, bear on Engerman and Sokoloff's (1997) argument that growth rates in the Americas were partly determined by factor endowments, through their impact on inequality and institutions. Here I argue that *changes* in factor endowments may also help to explain the nature

of that growth, in the sense of the evolution of economic structure.[3]

In Section 2 I briefly describe the process of development in Argentina over 1900 to 1973 and present the data on structural change. In Section 3 I analyze the extent to which the data support Díaz Alejandro's productivity-based explanation for structural change. In Section 4 I then present the model, and calibrate it to estimate the extent to which changes in factor endowments can explain the observed changes in economic structure. Section 5 concludes.

2 Economic Development and Structural Change in Argentina, 1900-1973

Argentina first grew rich during the Belle Epoque, from the late nineteenth century to the beginning of the Great Depression in 1929. It had developed a reputation as a great exporting nation and by 1913 was the tenth richest economy in the world in per capita terms;[4] over 2 million immigrants, the majority from Italy and Spain, had travelled across the Atlantic to find a better standard of living.[5] This period of growth was interrupted by the First World War, which caused substantial economic decline as both export markets and imports of key intermediate goods were disrupted. The economy returned to growth immediately after the war, but in per capita terms real GDP did not return to its 1913 level until the mid-1930s, after recovering from the Great Depression.[6]

Of particular importance for the analysis I present below, the Great Depression coincided with the closing of the land frontier. Land use had grown very rapidly before the First World War, with the total area of cultivated land tripling over 1900-1913. By 1913 Argentina's whole stock of high quality arable land was within reach of the railroad,[7] but land owners had not taken full advantage of this access until

[3] The mechanism in the model I develop is, however, different from that in Engerman and Sokoloff.

[4] Maddison (2001).

[5] Immigration data from Comité Nacional de Geografía (1941: 186).

[6] Cortés Conde (1997: 18-19).

[7] Cortés Conde (1979, p. 177-178).

twenty years later. The year 1934 is both the year in which the area of cultivated land stops growing, and in which total GDP returns to its 1929 high.

The early 1930s was also the point of transition from the Belle Epoque to the beginning of the import-substitution era. The Belle Epoque in Argentina had been characterized by the rapid expansion of exports and relatively free trade. Tariffs existed, but they were small compared to the protection subsequently enjoyed by domestic manufacturers.[8] The improvised attempts to shore up the balance of payments during the Great Depression in the early 1930s, including increased import tariffs, exchange controls, and currency devaluation, led almost accidentally to industrial protection.[9] These measures subsequently became part of an explicit strategy of import-substituting industrialization, also involving import quotas, differential exchange rates, and subsidized credit for industry. Some re-ordering of the industrial strategy was then attempted in the late 1960s, but the basic economic approach did not change radically until the military government of the late 1970s.[10] This explains the choice of the 1970s as the end of the period under analysis; I end with 1973 in particular because national accounts data are re-based after this year (see Appendix for discussion of the data).

The key change in economic structure that took place in Argentina over 1900-1973 was the relative decline in agriculture and the rise of manufacturing, in terms of both factor employment and output. Figure 1 shows log output, employment and capital stock in the three sectors agriculture, manufacturing and services.[11,12]

[8] Díaz Alejandro (1970: 282); Coatsworth and Williamson (2004).

[9] The main author of the policy response to the Great Depression, Raúl Prebisch, states that he and his team of economists did believe that industry needed to be promoted in order to reduce imports. However, "all public opinion was against industrialisation", so "[h]igh customs duties were imposed without stating that their purpose was to encourage industrialisation; the group of young men who were behind these steps were very careful not to make any reference to industrialisation" (Prebisch 1986: 134). Still, the purpose at this stage was to address the balance of payments deficit, not to promote industry for its own sake or to promote national self sufficiency *per se*.

[10] Katz and Kosacoff (2000); see Bruton (1998) for a discussion of ISI more generally.

[11] Capital stock data are fully disaggregated only up to 1955, after which I have data for the rural sector and the aggregated non-rural sector. See Appendix.

[12] GDP and aggregate factor employment variables are calculated as the sum of values in the rural sector, manufacturing, and services. Over 1935-73, the period for which current price data exist, the three sectors comprise 90 to 95 percent of the value of market output, excluding government services, and 80 to 88 percent of the total value of GDP including government services.

Growth in agriculture was lower than in manufacturing and services throughout the period, but the difference in growth rates was greater after 1929 than before. Over 1900-1929 agriculture grew at an average yearly rate of 4.0 percent, compared to 5.7 and 4.9 percent respectively in manufacturing and services, and 4.8 percent in the economy as a whole. The growth rate in agriculture was therefore 83 percent of the growth rate of the economy. Over 1929-1973 the agricultural growth rate dropped to 1.3 percent, less than half the growth rates of 4.5 percent in manufacturing, 3.0 percent in services, and 3.2 percent in the whole economy.[13]

Turning to factor employment, labour force growth in agriculture slowed and almost stopped in the mid-1930s, and indeed reversed around 1950, while growth in the capital stock dropped dramatically after 1929. The slowdown in growth of the capital stock after 1929 is economy-wide, but it picks up in the other two sectors in the mid-1940s at a much higher rate than in agriculture.[14] In fact, growth in the capital stock in agriculture had already started to lag behind the rest of the economy in the early 1920s, while agriculture's share of employment started to decline in the early 1930s. On a variety of measures, therefore, the picture is of a declining agricultural sector from the 1930s onwards.

3 The Productivity Explanation

Díaz Alejandro (1970) argues that a "technological lag", induced by the policies of ISI, was an important determinant of the relative decline of agriculture. I now examine the two components of this argument: first, that the policies of ISI reduced the relative price of agriculture, and second, that this led to a "technological lag" in the sector.

[13]Note that the higher growth rate in manufacturing before 1929 than after (following the higher growth rate in the economy as a whole) accords with Katz and Kosacoff's (2000) observation that industrial expansion started in Argentina long before ISI. In addition to Argentina, Haber (2006) makes a similar argument for Brazil, Chile and Mexico.

[14]The real investment rate in Argentina is somewhat controversial owing to a likely underestimation of the price of capital goods in official data under import substitution (Díaz Alejandro 1970: chapter 6). However, as far as I know *relative* rates of investment across sectors, as reported here, have not been questioned.

3.1 Relative Prices

How did relative prices evolve? Figure 2 shows two relative price series, all indexed to 1 in 1935. The series starting in 1913 is the wholesale price of agricultural goods divided by the wholesale price index for the whole economy. It is clear that relative agricultural prices so measured were substantially lower after 1930 than before, aside from a partial recovery in the late 1930s. The 1937 local peak is higher than any subsequent year in the period.

The series starting in 1935 is agriculture's price deflator divided by the GDP deflator, calculated using current price data at factor prices, and output indices, from national accounts (current price data are available only from 1935; see Appendix). Conceptually it is the national accounts counterpart of the wholesale price series. But while according to the wholesale price index the relative agricultural price was higher in the 1930s than subsequently, in the national accounts-based deflator series the agricultural price is on a steadily rising trend from 1935 onwards. Indeed, if the deflator series were to follow the wholesale price series before 1935, then the deflator series in the 1960s would be barely lower than before 1930. This suggests that one should exercise caution in describing relative price movements. However, it remains true that the only apparently-consistent series available for the longer period does indicate that the price level of agriculture was higher before the 1930s than after.

Relative prices of tradeables, of course, are determined not just by domestic policy but also by international prices. The large majority of Argentina's exports were agricultural products while most imports were manufactures and this suggests a comparison between the terms of trade and these domestic relative prices. The comparison should be treated with caution, however: manufactures comprised between 51 and 76 percent of the value of imports over 1950-73. Agriculture's share of exports was higher at about 90 percent up to the late 1960s, declining to about 80 percent in the early 1970s, but even in this case it is likely that the exact composition of agricultural goods consumed domestically was different from the composition

of agricultural exports.

Bearing in mind these qualifications, figure 3 repeats the wholesale price series in figure 2, along with the terms of trade, and the agriculture over manufacturing deflator, all indexed to 1935=1. The terms of trade are most comparable to the deflator series comparing agriculture to manufacturing, indicated by the shorter line in the figure. The wholesale price index has the advantage of being a longer series but the disadvantage of comparing agriculture with the whole economy, and not just manufactures. When the terms of trade are higher than the domestic relative price indices in the figure it means that the international price of agriculture is higher than the domestic price, relative to other sectors, such as would occur under a tariff on imported manufactures.

Consider first the comparison between the terms of trade and the relative wholesale price of agricultural goods to the whole economy. Compared with 1935, the relative domestic price of agriculture is higher than the terms of trade before 1930, lower from 1939 to 1955, and then broadly similar from 1956 to 1973 (recalling that they are set to be equal in 1935). Turning to the domestic price of agriculture relative to that of the manufacturing sector, starting in 1935, this series tracks the terms of trade until 1938 and then drops below it until 1970. The gap between the two widens over 1941-1955, and then again over 1965-1967. With agriculture facing better relative prices externally than internally before the 1930s compared to after the 1930s, these imperfect comparisons offer some support to the view that domestic policy such as tariffs and dual exchange rates disfavored agriculture during some of the ISI period, relative to policy before the 1930s.

This analysis confirms Díaz Alejandro's observation that domestic policy after the 1930s penalized agriculture (with reservations about data). I now turn to the question of whether this had any impact on output.

3.2 Relative Prices and Agricultural Output

The first question is whether relative prices had a significant contemporaneous impact on agricultural output. Díaz Alejandro regresses agricultural output on prices using data over 1929-1965 and finds no significant relationship, noting that "price elasticities are generally low and/or statistically insignificant" (p. 169). When I regress log agricultural output on relative wholesale prices, over 1913 to 1973, there is a strong correlation. However, this correlation is spurious. Both series appear to be non-stationary, with Augmented Dickey-Fuller test statistics below the 10% critical value. I therefore run an autoregressive distributed lag (ADL) model, including lags of the dependent and independent variables as regressors. I obtain the following results, where log agricultural output is $\ln Y_A$ and the log of the relative agricultural price $\ln P_A$, and an L prefix indicates a lagged variable:

$$\begin{aligned} \ln Y_A &= 0.46 + 0.89L \ln Y_A - 0.005 \ln P_A - 0.031L \ln P_A. \\ &\quad (0.23)\ (0.058) \qquad (0.059) \qquad (0.061) \end{aligned}$$

Standard errors are in brackets, indicating that the coefficients on relative prices and its lag are highly insignificant. There is thus no significant short-run relationship between agricultural output and relative agricultural prices.

3.3 Relative Productivity

The lack of a short-term relationship between agricultural output and prices implies that the claim that ISI deterred agricultural production has to be based on a longer-run argument, which brings us to Díaz Alejandro's claim of a technological lag. According to this view low relative prices discouraged agricultural business from investing in capital and technology, while the government failed to pick up the slack. Thus even if there is no contemporaneous relationship between prices and output, low agricultural prices may have had an impact in the long run. So I now consider relative productivity growth.

Díaz Alejandro (1970: 144) constructs a rough estimate of agricultural productivity by dividing an output index by a weighted average of input indices of land, labour and capital. Over the period 1935-39 to 1955-59 agricultural productivity so measured grew by 77 percent in the USA, and by only 29 percent in Argentina. Considering individual products, production levels of wheat and corn per hectare in Argentina were respectively 10 percent and 17 percent higher than in the USA over 1930-39, while over 1960-64 they were 13 percent and 55 percent *lower* (ibid., p. 194).

These figures clearly show that productivity in the Argentine agricultural sector fell behind international best practice. But if we are interested in the decline of agriculture in Argentina, rather than the decline of Argentina in the world economy, then the appropriate comparison is not with agricultural sectors of other countries but with the rest of the Argentine economy. Did productivity in agriculture lag behind the rest of the economy? I consider labour productivity rather than total factor productivity to allow for the possibility that price disincentives discouraged both capital investment and technical progress in agriculture, as both types of underinvestment would show up in low relative labour productivity. (We have already seen that the growth of the capital stock in agriculture fell behind that in the rest of the economy, but we have not established what impact this might have had.)

Figure 4 plots the ratio of labour productivity in manufacturing and services to labour productivity in agriculture, with a linear time trend, over 1930-73. The slope of the time trend is zero. Put another way, labour productivity using five-year averages grew by 86 percent in the non-agricultural economy from 1930-34 to 1969-73, while it grew by 87 percent in agriculture. Over the same period, also using five-year averages, non-agricultural output grew by 340 percent while agricultural output grew by a mere 71 percent (recall that agricultural employment declined). Evidently, differences in labour productivity do not explain the observed structural change, and the argument that agriculture fell behind the rest of the economy in

the sense of labour productivity growth is not supported by the data.[15]

However, by considering only labour productivity, figure 4 combines the impact of changes in total factor productivity with changes in the ratio of labour to other factors. This is intended to capture the fact that discrimination could have implied either a lower rate of TFP growth or a lower rate of capital deepening in agriculture, and therefore deliberately does not distinguish between these two sources of change in labour productivity. But with labour mobility, a real decline in the relative rate of investment or TFP growth might be disguised by the migration of labour from agriculture to the rest of the economy. As Díaz Alejandro (1970: 148) observes, if there are diminishing marginal returns to labour on a fixed quantity of land, then part of the rise in labour productivity in agriculture may have been due to the fall in agricultural employment.

We can describe this argument formally by assuming that output X_A in agriculture has a production function of the following form:

$$X_A = C_A F\left(T, K_A\right) L_A^{\beta}$$

where T is land, L_A labour employed in agriculture, K_A capital employed in agriculture, C_A Hicks-neutral technical change, and $F\left(.\right)$ is increasing, concave, and homogeneous of order $1-\beta$ (so X_A could, for instance, be Cobb-Douglas). Díaz Alejandro's argument implies that C_A and/or K_A grow at a lower rate than their counterparts in the rest of the economy, and by using labour productivity I am ignoring the possibility that an accompanying decline in L_A could mask this relative decline (given a constant T). Indeed, in general equilibrium with mobile

[15] Díaz Alejandro (1970: 146-47) argues that an apparent rise in land productivity of 8 percent over 1935/39 to 1955/39 (using five-year averages) is due to changes in land composition, with productivity within specific locations actually declining. However, his land index ignores natural pastures and shows land use rising by 8 percent over the period, whereas the index used here, which takes all land use into account, rises by only 2 percent. If 6 percent of land were transferred from natural pastures to some more productive use then it ought to be counted as a productivity gain. Moreover, his claim rests on the use of unpublished estimates from the *Consejo Nacional de Desarrollo*. Published data that he reports in the same table (p. 146) from the Central Bank show a much greater rise in productivity, and he gives no reason to prefer the former to the latter source for rural sector data.

labour, marginal labour productivity remains constant across sectors and a decline in $C_A F(T, K_A)$ compared with the rest of the economy would have to be offset by labour migration. Is figure 4 simply reflecting this effect?[16]

We can test this by observing that β is the labour share of value added in agriculture. Díaz Alejandro (1970: 123) reports estimates of this quantity over the period 1935-55, ranging between 19.0 and 23.3 percent. Using these estimates, which I approximate as 0.2, one can determine the impact of labour migration out of agriculture. Average labour productivity in agriculture is

$$\frac{X_A}{L_A} = C_A F(T, K_A) L_A^{\beta-1}.$$

If the labour force falls to $L'_A < L_A$ then labour productivity rises by a factor of

$$\frac{X'_A}{L'_A} / \frac{X_A}{L_A} = \left(\frac{L'_A}{L_A}\right)^{\beta-1}. \tag{1}$$

The five-year average of the agricultural labour force fell from 1.72 million workers over 1930-34 to 1.57 over 1969-73, a decline of 9 percent. Inserting 0.91 as the ratio of inputs of labour, and the labour share $\beta = 0.2$, into equation (1) tells us by how much labour migration raised labour productivity. These figures imply a rise in labour productivity of 7.8 percent. (A β of 0.15 would imply a rise of 8.3 percent, while a β of 0.3 would imply 6.8 percent.) Actual labour productivity in agriculture rose by 87.4 percent over the period from which we can subtract 7.8 percentage points which, according to this model, are due to the fall in the labour force. Thus, over a period of 39 years, capital deepening and technical change led to productivity growth of 80 percent in agriculture compared to 86 percent in the economy as a whole: the "technological lag" in agriculture was thus very small. Hence in general equilibrium, labour migration is not disguising a substantially deterred agricultural

[16] In fact, since figure 4 shows average labour productivity, this would only be true under the strong assumption that the ratio of marginal productivity to average productivity is constant, as in a Cobb-Douglas production function. Moreover, figure 4 shows labour productivity in terms of output at constant prices, whereas labour mobility would imply marginal labour productivity being equalised across sectors in terms of current prices.

sector.

My claim is not that agricultural productivity could not have been higher: international comparisons show that Argentina could have done considerably better. Moreover, given the importance of agriculture to Argentina's exports it can be argued that the government *should* have made a better effort at encouraging technical progress and investment in this sector. But the view that the relative decline in agricultural output was due to any special discrimination against the sector is inconsistent with the data on relative productivity growth: the Argentine economy as a whole may have grown slowly, but agriculture did not do particularly badly.

4 The Model: Factor Endowments and Structural Change

4.1 Price Elasticity and the Elasticity of Substitution

We saw above that relative agricultural prices did not affect agricultural output. This need not imply that farmers' supply curves are vertical as it may partly reflect movements of, rather than along, supply curves. But it does imply that these factors together add up to a general equilibrium price elasticity insignificantly different from zero. So what might explain this?

First consider land, which is unlike labour and capital in that it is specific to one sector. Given this, land use should vary with the output price only if land has variable productivity, with some portion of it being marginal in the sense of having a level of productivity that makes it profitable to use only when prices are relatively high. Does land use correlate with prices? The cultivated land series appears to be non-stationary over 1913-1973,[17] and again an ADL model produces no significant correlation between land use and the relative price or its lag.[18] However, taking Díaz-Alejandro's starting year of 1929, and going through to 1973, the land series

[17] The Augmented Dickey-Fuller test statistic is -2.575, almost, but not quite, at the 10% critical value of -2.596.

[18] Using data over 1913-1973 we estimate the following ADL model, with standard errors in

is stationary, and over this period regressing land use on differenced prices also produces no correlation.[19] The lack of a relationship between prices and land use suggests that marginal lands comprise no more than a small share of the total stock. The model therefore treats land as homogeneous, which is of course the standard assumption for labour and capital.

But even with fixed and homogeneous land, neoclassical production functions would imply that high prices would draw more labour and capital on to the land, raising output. The lack of a correlation between prices and output therefore implies that the elasticity of substitution between factors must be very low. This is of course not generally true: a survey by Wood (1994: 133-34) finds that the elasticity of substitution between labour and capital is typically estimated at between 0.5 and 1.2 for developing countries (between 0.5 and 1.5 for developed countries). But the fact that prices have no impact on output in the Argentine data suggests that the elasticitiy of substitution between land and other factors is at least very low in this case.

The model therefore assumes zero elasticity of substitution between factors, i.e. fixed-coefficient production functions. Since there is no discontinuity in the implied effect on output between low and zero elasticities, the model may provide a reasonable approximation to reality even if the true elasticities are slightly greater than zero. The intention, then, is to see how closely the model will replicate the data on these assumptions. If we find that the model fits the data well then this is further evidence that the elasticities in question were indeed small enough to be of limited importance in the determination of structural change.

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brackets:

$$\begin{array}{rcl} \ln land & = & 2.46 + 0.76L \ln land + 0.014 \ln Pa - 0.052L \ln Pa. \\ & & \begin{array}{cccc} (0.88) & (0.087) & (0.063) & (0.062) \end{array} \end{array}$$

[19] Using data over 1929-1973, with $D \ln Pa$ representing $\ln Pa$ differenced,

$$\begin{array}{rcl} \ln land & = & 10.2 + 0.11D \ln Pa. \\ & & \begin{array}{cc} (0.079) & (0.085) \end{array} \end{array}$$

Clearly I do not suggest that radical changes in relative prices would make no difference to relative output. The regression that indicated no relationship implies that there is no relationship only within the range of relative prices found in the data. It is highly implausible that more radical changes in prices would have had no impact. Equally, the assumptions of the model are taken to hold only over the range of prices found in the data.

4.2 The Model

The model is a special case of a standard three-by-three model where, as discussed above, the elasticity of substitution between factors is zero. The three sectors are agriculture A, manufactures M, and services S. Output X_j in sector j is determined by sector-specific factor employment L_j, K_j and, for agriculture, T_A, and by exogenous unit factor requirements a_{ij} of factor i (I allow these to vary later). I assume full employment of labour L, capital K and land T.

$$X_A = \frac{L_A}{a_{LA}} = \frac{K_A}{a_{KA}} = \frac{T_A}{a_{TA}} \tag{2}$$

$$X_M = \frac{L_M}{a_{LM}} = \frac{K_M}{a_{KM}} \tag{3}$$

$$X_S = \frac{L_S}{a_{LS}} = \frac{K_S}{a_{KS}} \tag{4}$$

$$L = L_A + L_D + L_S \tag{5}$$

$$K = K_A + K_D + K_S \tag{6}$$

$$T = T_A. \tag{7}$$

With three sectors and three factors, and given unit factor requirements, the vector of outputs is uniquely determined by the vector of factor endowments (T, L, K). In fact, the production side is even easier to solve than a generic three-by-three model because only agriculture uses land. If it is profitable to produce any agriculture then linearity implies that the total endowment T of land will be used, so

$T_A = T$ and agricultural output will be

$$X_A = \frac{T}{a_{TA}}. \tag{8}$$

Then L_A and K_A are determined by (2) and we are left with a two-sector, two-factor model in manufacturing and services where the employment vectors add up to the non-agricultural endowment vector $(\bar{L}, \bar{K}) \equiv (L - L_A, K - K_A)$. Solving for employment of L and K in manufacturing and services, we derive the following output equations:

$$X_A = \frac{T}{a_{TA}} \tag{9}$$

$$X_M = \frac{La_{KS} - Ka_{LS} - |a_{AS}|T/a_{TA}}{|a_{MS}|} \tag{10}$$

$$X_S = \frac{Ka_{LM} - La_{KM} - |a_{MA}|T/a_{TA}}{|a_{MS}|} \tag{11}$$

where

$$|a_{ij}| \equiv a_{Li}a_{Kj} - a_{Lj}a_{Ki}.$$

Output is illustrated in (L, K) space in figure 5, where manufacturing is shown as the most labour intensive sector and services the most capital intensive sector, as is found in the Argentine data.[20] As can be inferred from the figure, full employment implies standard Rybczynski-like results as relative output across sectors varies to clear factor markets. For instance, a rise in T leads to a rise in output in A and a fall in output in the other two sectors, as agriculture draws labour and capital away from the rest of the economy. A rise in L will lead to a rise in manufacturing and a fall in services (and conversely for a rise in K), but will have no impact on agriculture owing to the fact that this is the only sector that uses land.

Unit factor requirements, the a_{ij}'s, clearly change over time: technical change, capital deepening, and increased human capital all reduce unit labour requirements.

[20] Services includes both housing and transport, including railways, which are highly capital intensive.

So to allow for these three effects I make two further assumptions: I allow for capital deepening by allowing the a_{Kj}'s to rise over time, and I allow the a_{Lj}'s to fall by augmenting the production functions with Hicks-neutral technical change C (so unit factor requirements are now a_{ij}/C). The decline in unit labour requirements implied by the technical change term is assumed to account for a combination of improvements in technology per se, capital deepening, and improvements in human capital as the labour force becomes better educated over the period.

While the a_{ij}'s do change, we saw above that labour productivity grew at approximately the same rate in the agricultural sector and the rest of the economy. I therefore assume that changes in unit factor requirements are uniform across sectors. I impose uniform capital deepening and technical change across all three sectors by using aggregate values, taken from the whole economy, to augment the production equations. I first take an average of the a_{ij}'s over the period in question, and denote them $\bar{a}_{ij}$. To account for capital deepening, I allow the a_{Kj}'s to vary uniformly with the aggregate capital-labour ratio, with the base year denoted 0. Thus a_{Lj} is replaced by $\bar{a}_{Lj}$ and a_{Kj} is replaced by

$$a^*_{Kjt} \equiv \bar{a}_{Kj} \frac{K_t L_0}{L_t K_0}.$$

The a^*_{Kjt}'s rise and decline with the aggregate capital-labour ratio.

To allow for uniform rises in labour productivity I then multiply output by the rise in aggregate labour productivity in the whole economy, again setting a base year 0. This implies a technical change factor of $C_t \equiv \frac{Y_t L_0}{L_t Y_0}$, which again can be calculated from the data. Then replacing a_{Lj} with $\bar{a}_{Lj}$ and a_{Kj} with a^*_{Kj}, the output equations 9, 10, and 11 now become

$$X_{At} = C_t \frac{T_t}{\bar{a}_{TA}} \tag{12}$$

$$X_{Mt} = C_t \frac{\bar{a}_{KS} - \bar{a}_{LS}\frac{K_0}{L_0}}{|\bar{a}_{MS}|} L_t - C_t \frac{|\bar{a}_{AS}|}{|\bar{a}_{MS}|\,\bar{a}_{TA}} T_t \tag{13}$$

$$X_{St} = C_t \frac{\bar{a}_{LM}\frac{K_0}{L_0} - \bar{a}_{KM}}{|\bar{a}_{MS}|} L_t - C_t \frac{|\bar{a}_{MA}|}{|\bar{a}_{MS}|\,\bar{a}_{TA}} T_t. \tag{14b}$$

The fact that $\bar{a}_{LS}$ in and $\bar{a}_{LM}$ in are now multiplied by $L_t\frac{K_0}{L_0}$ instead of K_t has the same effect as assuming that K grows at the same rate as L, with the aggregate capital-labour ratio held at its value in the index year. Referring back to figure 5, it implies that the endowment vector moves out along the 45° line in L, K space (with output in all sectors additionally being multiplied by C_t). Changes in relative output are thus driven entirely by population growth relative to the land stock, following the discussions of Bunge (1920) and Di Tella (1970).[21]

4.3 Calibration

In order to calibrate the model, consider the actual unit factor requirements in the Argentine data. Figure 6 repeats the data on total labour and capital in the economy from figure 1, alongside data on thousands of hectares of land under cultivation. As previously mentioned, land use rises rapidly up to 1914, more slowly to 1934, and is then relatively flat with no clear trend to the end of the period. The working population rises throughout the period, while the capital stock grows slowly until about 1950 and then grows more rapidly. The capital-labour ratio in the economy is therefore rising over the period, as shown in figure 7, so capital deepening presumably plays a role in rising labour productivity.[22]

The calibration requires an average $\bar{a}_{ij}$ of the the a_{ij}'s - the unit factor require-

[21] This also implies that in calibrating the model we do not have to worry about the possibility of the capital stock being mis-measured (Díaz Alejandro 1970: chapter 6).

[22] Indices of output and the capital stock are measured at 1950 prices over 1900-55 and at 1960 prices from 1956-73. There is therefore a change of basket used in the calculations. This might explain a step change in capital-output ratios at the break point but it cannot explain the continuing rise after 1955.

ments - over the period, calculated from sectoral output and employment data, and an index year for the capital-labour ratio. I use 1935 as the index year because the Argentine economy has completed its recovery from the Great Depression so the economy can be assumed to be at full capacity, the land frontier has just been reached, and it is approximately the beginning of the ISI period.

Figure 8 gives the results of the calibration, plotting simluations of log output, and sectoral output as a share of total output, alongside the original data. The first point to make is that the *average* trend in the calibrated model is derived directly from the data through technical change C_t, so the fact that total output in the calibration rises at about the same rate as total output in the data provides little support for the model. More relevant in figure 8 is output of each sector as a share of total output, in which technical change plays no part (C_t cancels out). Agriculture and manufacturing are poorly estimated before 1920, but much better thereafter. The estimation of the agricultural sector fits the data closely from this point onwards. The estimation of the manufacturing sector follows the trend of the data while slightly underestimating the level. Conversely, services are slightly overestimated through most of the period, but also track the trend in the data by keeping a fairly constant share of total output over the whole period. In both the data and the calibration, manufacturing overtakes agriculture in 1945.

Thus structural change from the 1920s on, including the ISI period, is replicated in the calibration. Before the 1920s differences across sectors in the unit factor requirements evidently prevent the simple model from reproducing the output data. But the calibration suggests that the relative decline in agriculture during the ISI period from the 1930s, and the concomitant rise in manufacturing, can be accounted for simply by changes in factor endowments.

4.4 Are Endowments of Land and Labour Exogenous?

The above model assumes that the growth of the population and the stagnation of the area of cultivated land are exogenous. But is this assumption plausible?

Considering population growth first, the assumption of exogeneity with respect to economic variables is implausible before 1930, but plausible from the Great Depression onwards. Immigration was very important for Argentina during the Belle Epoque, driven by the high wages that European immigrants could earn. Over 1857-1930 Argentina absorbed a net 3.38 million immigrants, and an average of 85,500 per year over 1901-30.[23] Scobie (1964: 60-61) writes that for a migrant worker from Italy or Spain, "four to five months' labour in the wheat-corn harvest could bring from forty to fifty pounds sterling - five to ten times what he could earn in his homeland", while Cortés Conde (1979: 265) estimates that real wages in Argentina at the beginning of the twentieth century were about double those in Italy. Moreover, Cortés Conde finds that the level of immigration rose and fell over time with the level of wages in Argentina. It therefore seems clear that the size of the labour force was endogenous to the wage level before 1930.

During the Great Depression, however, immigration collapsed, to a total of only 4,400 over the three years 1932-1934. Cortés Conde (2000: 276-8) notes that over 1895-1914 immigration's contribution to population growth was 17.2 per thousand, while over 1914-47 this dropped to only three per thousand. Immigration from Europe did pick up again in the years following the Second World War, but this was driven by political rather than economic factors.

It therefore seems reasonable to assume that the level of earnings ceased to be a factor driving immigration after 1930 and that population growth was exogenous from this period onwards. Since this is the period from which ISI was supposed to have deterred productivity growth in agriculture, the assumption of exogenous population growth appears to be valid.

Turning to the use of land, the argument implicit in the model is that marginal lands - those whose productivity level is such that the observed range of agricultural prices can make a difference to whether or not they are profitable to cultivate - comprise a small enough share of the total land stock to ignore. There is of course

[23] Comité Nacional de Geografía (1941: 186), cited by Díaz Alejandro (1970: 23).

some price at which a large share of land would not be profitable but, as mentioned above, the claim here is that actual agricultural prices did not fall to such a level.

The first piece of evidence is the fact that land use varies little once it has first reached a high point of 28.5 million hectares in 1934. Its lowest levels are reached in 1950 and 1952 when cultivated land drops to 24 million hectares, but these are both years of droughts. 25 million hectares were cultivated in 1948-49, but aside from this period the area cultivated never dips below 26.2 million hectares. Hence marginal lands do indeed appear to comprise a very small share of the total, and the variability appears to be due more to weather conditions than economic incentives, consistent with Díaz Alejandro's (1970: 169) finding that rainfall is significant in explaining short run agricultural output while relative prices are not.

Perhaps even more significantly, once ISI was over, land use did not grow in response to changed economic policies. The consistent series of total cultivated land extends to 1984, covering the radical economic opening of the dictatorship of 1976-1983 in which the trade policies of ISI were reversed. During this period the area of cultivated land never exceeded 28.6 million hectares, which was no higher than its level in the late 1950s. Thus the constraint on the amount of cultivated land was the reaching of the arable frontier, not policy-induced price incentives.[24]

The fact that the collapse of ISI in the late 1970s did not affect the area of cultivated land supports the view that the amount of land available for cultivation was exogenous with respect to economic variables, and the low variability of land use implies that marginal lands comprised a small share of the total.

[24]Data on the area of land sown with grains and oil seeds (excluding fodder cultivations) are available to the present day. This area never exceeds 23 million hectares up to 1995, but in 1996 it broke its previous record and by 2002 was up to 27.4 million hectares. This new growth is apparently due to the introduction of genetically modified soy that can be cultivated on land unsuitable for other crops. The area of land sown with non-soy crops actually declined after 1996, with the growth in land sown with soy accounting for (more than) the whole recorded rise in land use. (Miguel Teubal, private conversation, Buenos Aires, May 2004. Data from the Secretaría de Agricultura, Ganaderia, Pesca y Alimentos, downloaded from http://www.sagpya.mecon.gov.ar/, May 2004)

5 Conclusion

This paper analyzed the evolution of the structure of the Argentine economy over 1900-1973, a period that included the height of the Belle Epoque and the period of import-substituting industrialization. Opposing interests between economic sectors has been a continuous source of conflict in Argentina, and in this context the relative decline of the agricultural sector, and the concomitant rise of manufacturing, have been the source of substantial debate.

I formalized two explanations for this structural change and compared them with the Argentine data. I first considered the argument that ISI disfavored agricultural prices and therefore led to a relative decline in agricultural productivity growth. The data support the view that ISI lowered relative agricultural prices, but do not support the view that agricultural productivity lagged behind the rest of the economy, even when labour migration is taken into account. I also found, in accordance with Díaz Alejandro, that short term movements in relative agricultural prices did not affect agricultural output.

Following these empirical findings, I then developed a simple model of structural change in which changes in the structure of output is driven only by changes in factor endowments, with technical change and capital deepening assumed to proceed at the same rate in all sectors.

The model was then calibrated to show the extent to which changes in factor endowments could explain the observed structural change in Argentina over 1900-1973. The calibration performed well from the 1920s through to the end of the period. In particular, it reproduced the decline in the share of agriculture in total output, and the rise in manufacturing, during the ISI period. Thus the common view that ISI led to relative stagnation in the Argentine agricultural sector does not appear to be correct. Rather, the rise in manufacturing and the stagnation of agriculture under ISI can be explained simply by the dynamics of a growing labour force once the land frontier had been reached.

Appendix: Data Sources

Two sources are particularly important for historical data on the Argentine economy. In 1958 the Economic Commission for Latin America (ECLA) published a major study on economic development in Argentina titled *El Desarrollo Económico de la Argentina*. The statistical appendix to this study contains a wide range of data over the period 1900-1955, including output, capital stock and employment by sector. This is also one of the main sources used by Díaz Alejandro (1970). The document is hard to find and, indeed, I have never seen a hard copy of it. However, the office of the Economic Commission for Latin America and the Caribbean in Santiago de Chile have agreed to scan the entire document and put it online, so that it can now be downloaded.[25]

The second important source is a special edition of the journal *Estudios* in 1986, published by the *Instituto de Estudios Económicos sobre la Realidad Argentina y Latinoamericana* (IEERAL). This source, hereafter referred to as IEERAL, presents a large number of estimated series, most running from 1913 to 1984. The IEERAL data and some others are provided in digital form in the CD that comes with Della Paolera and Taylor (2003). This CD is a very convenient source, but Della Paolera and Taylor do not report details of the methodology used in estimating the series. I therefore refer to IEERAL itself for this information, and in general I try to find the original source of any estimate in order to get documentation on methodology.

Beyond these two sources the Argentine Central Bank (BCRA) is the main source of official national accounts data. Díaz Alejandro (1970) is itself also a rich source of data on the Argentine economy, but is a secondary source: like many of the IEERAL series, it generally reports estimates made by others. Again, in these cases I obtain the original source and then refer to it directly, where possible.

Argentine exports during the period under analysis included livestock-based products such as meat, hides and wool. Sources in Spanish use the word *agropecuario*

[25] From the Official Documents System of the United Nations at http://documents.un.org/simple.asp, where one types in the code E/CN.12/429/ADD.4 to locate the pdf file. Also available on request from the author.

to refer to both agriculture and livestock-based products. For convenience I translate this simply as *agriculture*, following Mundlak et al. (1989) and Della Paolera and Taylor (2003) (Díaz Alejandro uses the more accurate, but more cumbersome, "rural sector"). The assumptions regarding the primary sector in the model apply to this sector as a whole and not just its strictly agricultural component: livestock products are exported, and are also intensive in the use of land, with fodder cultivations occupying about one third of total cultivated land over the period.

In addition to agriculture, I report data on manufacturing and services. The precise definitions used vary slightly over time as sources change, but are always very close to the following aggregates (based on the 1993 System of National Accounts):

- Agriculture, denoted A: Agriculture, livestock, hunting, forestry, and fishing.
- Manufacturing, denoted M: Manufacturing industry.
- Services, denoted S: wholesale and retail trade; restaurants and hotels; transport, storage and communication; financial intermediation; real estate and business services; community, social and personal services.

Over 1935-73, the period for which current price data exist, the three sectors comprise 90 to 95 percent of the value of market output, excluding government services, and 80 to 88 percent of the total value of GDP including government services.

Output: Sectoral output indices over 1900-1973 are at 1950 prices. For 1900-1955 the source is ECLA (1958), and for 1956-1973 it is BCRA (1975). The BCRA data cover 1950-1973 but they are at 1960 prices, so I splice the two series by using the growth rate derived from the BCRA data indexed to ECLA's 1950 value. The use of a 1960 basket in calculating growth from 1956 may of course add a degree of imprecision to the data, inevitable in the use of such long-run output indices.

Sectoral output at current prices is available from 1935. For 1935-1949 I use estimates due to *Secretaría de Asuntos Economicos*, published in BCRA (1976). For 1950-1973 the source is BCRA (1975). The former data series goes up to 1962

but I use the BCRA series from the earliest point possible because of a reported under-estimation in the value of manufacturing by the earlier source (Díaz Alejandro 1970, p. 392). According to the *Secretaría*, manufacturing comprised between 18 and 22 percent of the value of total GDP over the period 1950-1962, when the two sources overlap, compared with the later BCRA estimate of between 25 and 30 percent.

Prices: Relative sectoral price indices are calculated by comparing the evolution of output at current prices with output at constant 1950 prices. Let the subscript i denote sector and the subscript t denote the year, with X_{it} output in sector i in year t and p_{it} its price. Y denotes total output of GDP, while p_{Yt} denotes the overall price level of GDP in year t. The data are output at current prices, $p_{it}X_{it}$ and $p_{Yt}Y_t$, and output at constant 1950 prices, $p_{i50}X_{it}$ and $p_{Y50}Y_t$. Manipulation of these composite terms yields the following formula for deriving e.g. the price of domestic manufactures M relative to agriculture A:

$$\frac{p_{Mt}}{p_{M50}} / \frac{p_{At}}{p_{A50}} = \frac{p_{Mt}}{p_{At}} . \frac{p_{A50}}{p_{M50}}.$$

This is equal to 1 in 1950 by construction, and I re-index to 1935, the starting year of the series.

I also use wholesale price indices over the period 1913-1973, which are available for agriculture, "non-agriculture" excluding government, the government sector, and total GDP. These data are from IEERAL (1986), which spliced a variety of sources to create the indices.

Terms of trade data for 1913-1973 are calculated as the unit dollar export price divided by the unit dollar import price, both series from IEERAL. These series are originally due to BCRA up to 1928, and ECLA sources subsequently.

Factor endowments: The *land* variable I use is defined as total cultivated land, which includes all land used for grains, oilseeds, vegetables, industrial crops, fodder cultivations, and fruits. The data are from several sources. For 1900-1936 I use *Ministerio de Agricultura* (1937); for 1937-62 I use data from the *Revista de la*

Bolsa de Cereales, Numero Estadistico (1963), which are reported in Díaz Alejandro (1970: 442). Finally, for the period 1963-1973 I use data from IEERAL.

Employment data by sector are taken from several different sources over the period. For 1900-1947 I use ECLA data. They present 5-year averages, which I smooth over time. For 1947-1961 I use data due to the *Consejo Nacional de Desarrollo* (CONADE), which are quoted in Díaz-Alejandro (1970). Finally, over 1962-1973 I use estimates by Llach and Sánchez (1984), scaled to equal the CONADE value in 1961. Llach and Sánchez provide estimates over the period 1947-1980,[26] and where they overlap with the CONADE estimates the two sets of series are very close (see Segal 2007, Chapter 3, for a detailed comparison).

Capital stock estimates by sector are from ECLA, at 1950 prices, for the period 1900-1955. For 1956-1973 I use IEERAL, which provides capital stock indices for agriculture and the whole economy at 1960 prices, but does not provide data for manufacturing or services. I scale the IEERAL indices to the ECLA values in 1955. The IEERAL data start in 1913, and the data from the two sources are extremely close for each of agriculture and the total capital stock (again, see Segal 2007, Chapter 3, for further discussion).

[26] They have estimates of formal employment from 1940, but their estimates of total employment, both formal and informal, start in 1947.

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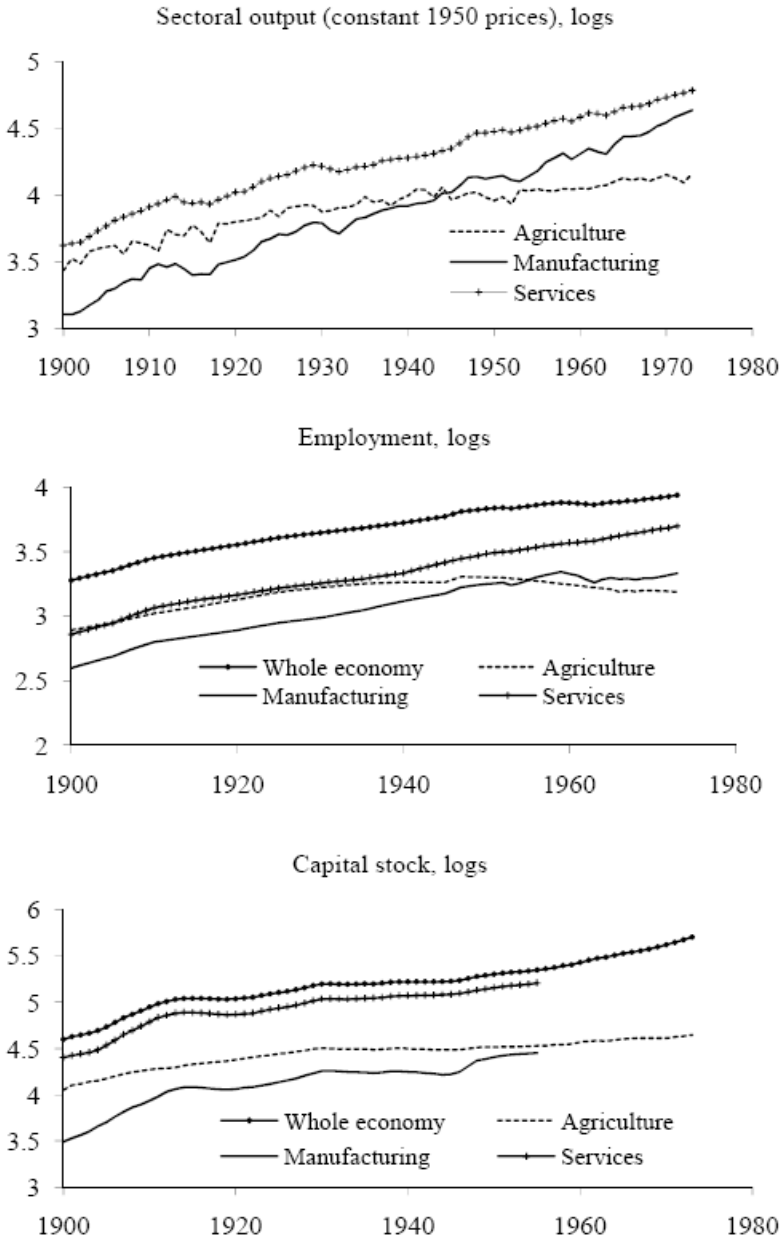
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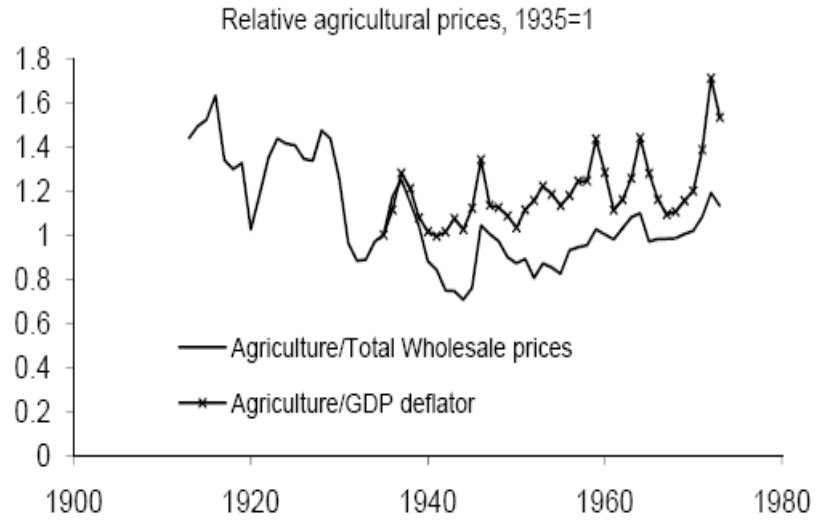
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Figure 1: Output and employment by sector



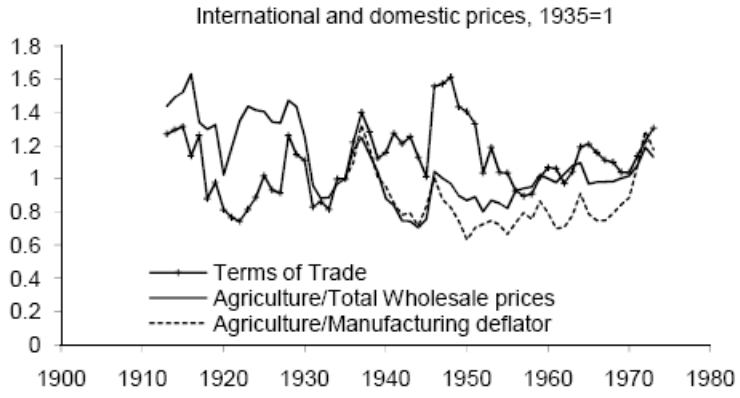
Sources: Output: ECLA for 1900-1955; BCRA (1975) for 1950-1973.
Employment: ECLA (smoothed) for 1900-1947; Díaz Alejandro (1970) for 1948-1961; Llach and Sanchez (1984) for 1962-1973.
Capital stock: ECLA for 1900-1955; IEERAL for 1956-1973.

Figure 2: Relative prices



Source: Author's calculations based on IEERAL.

Figure 3: Terms of trade and relative domestic prices



Source: Prices as in figure 2; for terms of trade, see Appendix.

Figure 4: Relative productivity



Source: Author's calculations.

Figure 5: Factor endowments and employment

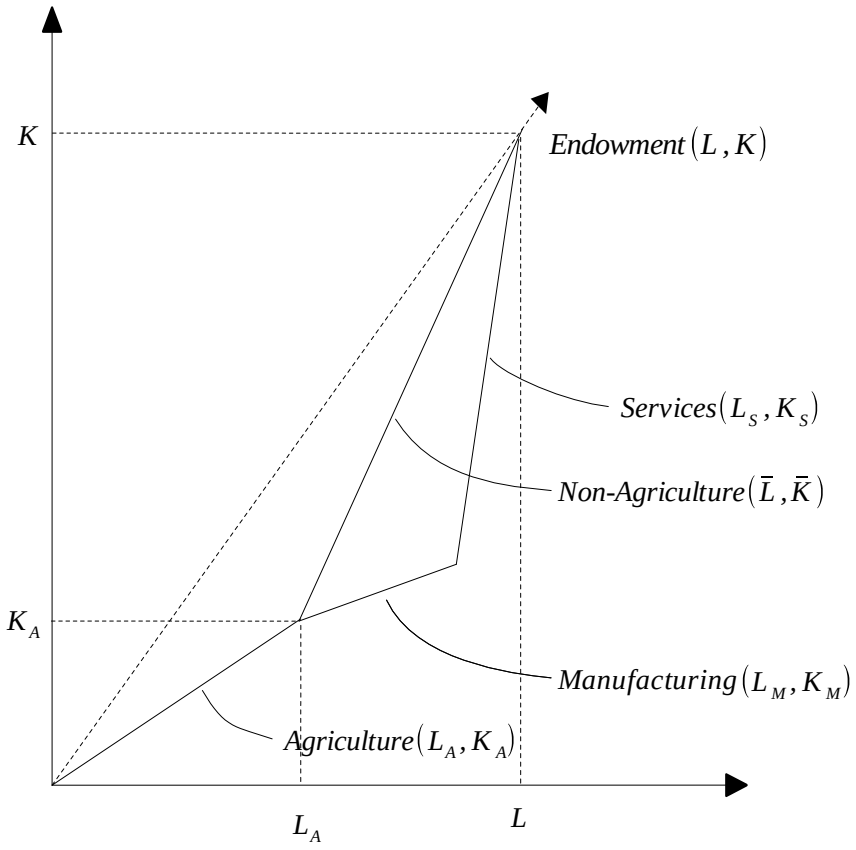
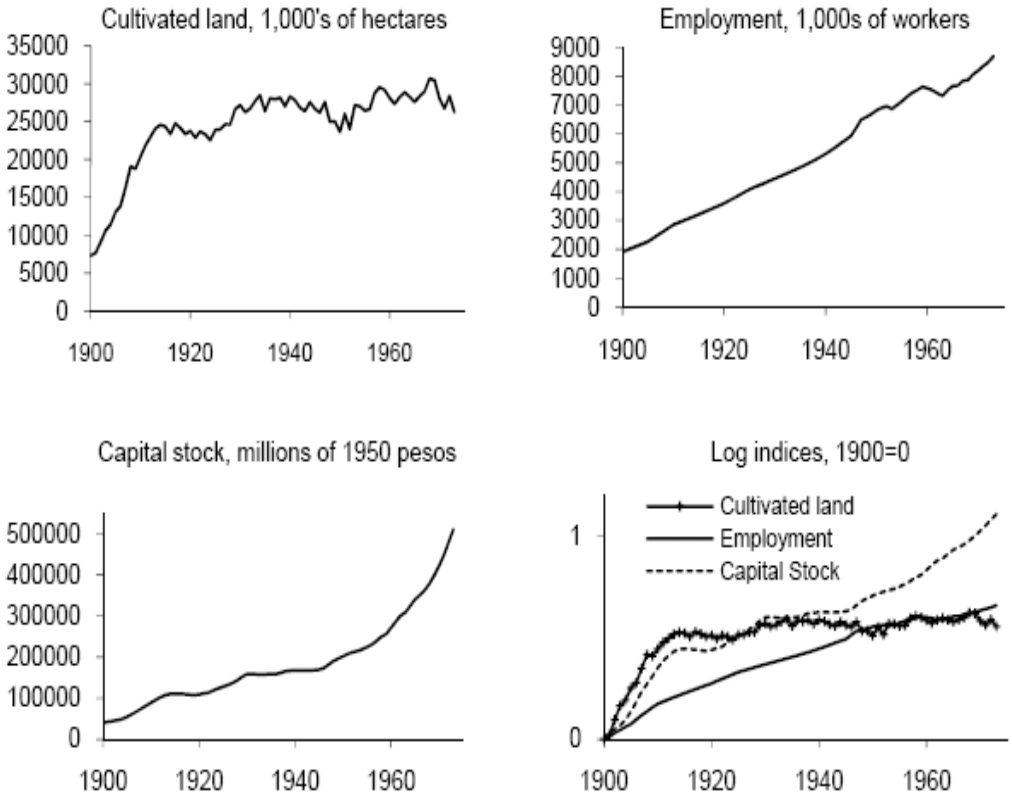
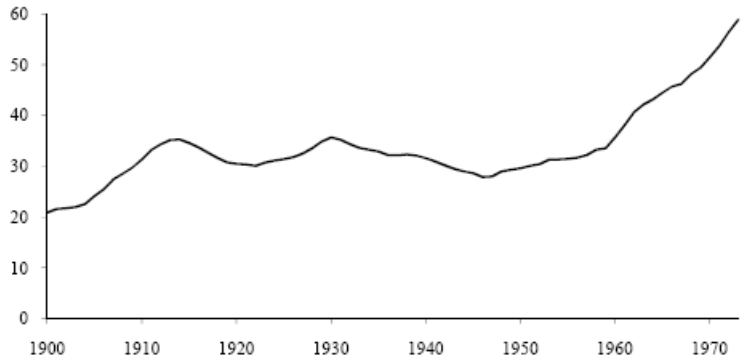


Figure 6: Factor endowments



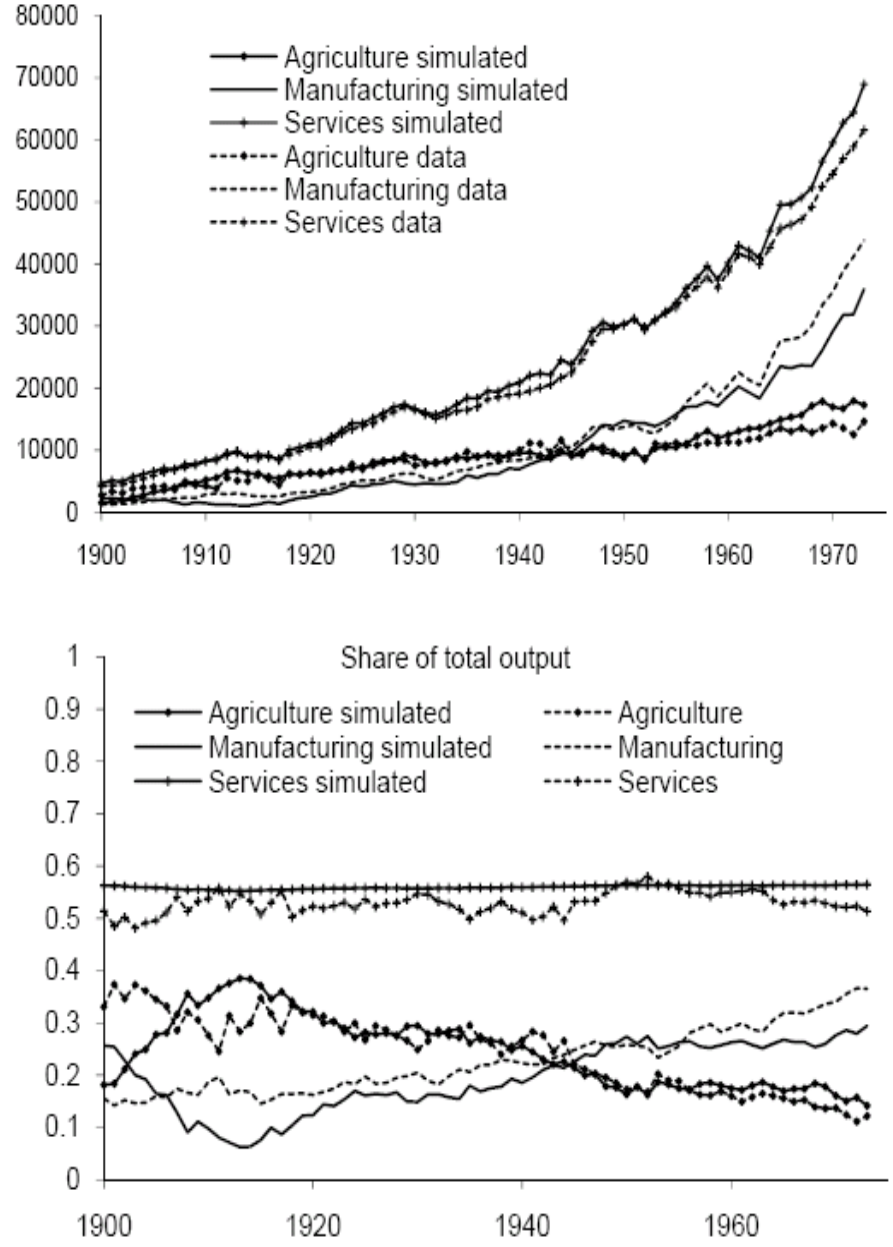
Source: For employment and capital stock, see figure 1. For cultivated land, Ministerio de Agricultura (1937) for 1900-1936, Díaz Alejandro (1970) for 1937-62, and IEERAL for 1963-1973.

Figure 7: Capital-labor ratio



Source: Author's calculations.

Figure 8: Simulated output and data



Source: Author's calculations.