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ABSTRACT

A Third World data base documenting commodity and factor prices 1870-1940 has been collected, yielding annual time series on wage/rental ratios, land/labor ratios, the terms of trade, and other explanatory variables for: Argentina, Burma, Egypt, Japan, Korea, the Punjab, Taiwan, Thailand and Uruguay. These 9 have been added to a previously-collected data base for 10 in the so-called greater Atlantic economy: Australia, Britain, Canada, Denmark, France, Germany, Ireland, Spain, Sweden and the USA. These 19 countries form the panel data base which is used to explore the determinants of wage/rental ratios the world round between 1870 and 1940. The data offer a useful way to identify the impact of globalization on the pre-industrial Third World. This paper finds commodity price convergence to have been bigger in the Third World than the Atlantic economy. It also identifies the sources of a previously-unnoticed but enormous convergence in wage/rental ratios. Commodity price convergence and factor supply responses appear to be an important source of the relative factor price convergence in the Third World, more clearly exposed by the absence of significant industrialization and capital-deepening forces there prior to 1940.

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1. The Agenda

This paper uses a new panel data base to document pre-1940 relative factor price convergence within the Third World, and between it and Europe plus its offshoots. The factor price convergence experience documented in Section 4 exhibits two regimes, one of dramatic convergence prior to World War I followed by another in the interwar years of sharp slowdown or even reversal. These two regimes reflected distinctly different policy attitudes towards globalization. Prior to World War I, trade was relatively free, capital flowed in abundance, and mass migrations were tolerated or even encouraged. These policy attributes held with even greater force in the Third World than in the Atlantic economy, but all of this changed after World War I: trade policy became autarkic, mass migration was restricted to a trickle, and world capital markets disintegrated in response to government intervention and great depression meltdown. Asia (with the exception of Japan), the Middle East and Latin America were pre-industrial economies at that time, and thus the factor inputs that mattered were land and labor, while the factor prices that mattered were unskilled wages and agricultural land rents.

The remainder of this paper searches for explanations of the wage-rental ratio convergence. Section 2 documents dramatic commodity price convergence within the Third World as well as between it and Europe plus its overseas settlements (what we will call the greater Atlantic economy, or simply the Atlantic economy for short). The rate of commodity price convergence was, predictably, far greater prior to World War I than in the two or three decades that followed. The pre-World War I convergence was driven by transport revolutions – even more spectacular in Asia and the Middle East than in the Atlantic economy, and by unusually liberal trade policy – far more so in Asia and the Middle East than in the Atlantic economy. This panel data base on commodity prices takes the form of two terms of trade measures: the price of agricultural relative to manufactured goods, and the price of exports relative to imports. This data base is very different from that which generated the famous Prebisch-Singer hypothesis about the twentieth century deterioration in the relative price of primary products since the ones used in this paper are quoted in *home* markets – instead of some European trade center like London or Amsterdam, and it is *specific to some country* for which we want to assess the price shock impact -- instead of some generic primary product like cotton or copper.

Section 3 reviews the simple but powerful trade theory which shows how price shocks get translated into factor price effects. It also shows how changes in factor endowments can do the same. For pre-industrial economies in which technology is relatively stable and human or physical capital deepening is relatively modest, changes in relative prices and land-labor ratios are likely to be enough to account for most of the factor price changes observed. If this was true for the Third World prior to 1940, then the debate is free to move on to the causes of both the price shocks and the factor supply responses. Was it true? For the industrializing Atlantic economies, changes in relative prices and land-labor ratios are unlikely to be enough, since we need to control for the forces of technological change and capital-deepening. Section 5 presents some preliminary results and an agenda on how they might be improved.

2. Commodity Price Convergence and Third World Terms of Trade Trends Before 1940

Terms of Trade Assertions and Debates

Transport costs dropped very fast in the century prior to World War I, a century to which Kevin O'Rourke and I (1999b) recently assigned the "globalization big bang" label. In the Atlantic economy, these globalization forces were powerful, but they were partially offset by a rising tide of protection which reached a crescendo during the interwar period (Williamson 1998; O'Rourke and Williamson 1999a). This political backlash was absent in Asia, the eastern Mediterranean, North Africa, and even some parts of Latin America, partly because they were colonies of free traders, partly because of the power of gunboat diplomacy, and partly because of the political clout carried by those locals who controlled the natural resources that were the base of their exports. As a result, the price shocks in the Third World are likely to have been even bigger and more ubiquitous than those which occurred in the Atlantic economy: that is, commodity price convergence between the European industrial core and what came to be called the Third World was likely to have been even more dramatic than within the Atlantic economy.

The standard Samuelson-extended Heckscher-Ohlin model assumes two mobile factors (capital and labor) and two tradable commodities, and even under those limiting assumptions changes in commodity prices can induce changes in factor prices. Under really extreme assumptions, factor price equalization will result. Under less extreme assumptions, factor price convergence will take place. While I will be more precise in Section 3, Heckscher-Ohlin theory has also shown that commodity prices should have a bigger impact on factor prices in 3x2 than in 2x2 models. The additional factor in the 3x2 pre-1940 model is a sector-specific resource like land.[1] Although there were certainly other forces at work, the pre-1914 evidence from the Atlantic economy seems to confirm the prediction of Heckscher and Ohlin thinking (O'Rourke and Williamson 1994, 1995, 1996, 1999b; O'Rourke, Taylor and Williamson 1996).

I expect to see much bigger effects in the Third World, and for three reasons. First, the price shocks were likely to have been bigger, for the reasons already given. Second, the price shocks were also likely to have been bigger because the "small country" assumptions were more likely to hold for most Third World countries. Third, land and other natural resources were much more important factor endowments in the Third World, and they were sector-specific and immobile. Trade theory has shown that the impact on relative factor prices (and, thus, income and wealth distribution) is much bigger in this kind of 3x2 model: that is, changes in the returns to land (held by those at the top) relative to both labor and capital is far bigger in the 3x2 model than between capital (held by those near the top) and labor (the masses around the bottom) in the 2x2 model.

[1] The additional factor in a post-1950 model might be an input like human capital, specific to the "manufacturing" sector.

Recent work on the Atlantic economy has confirmed what theory has always told us: most of the globalization debates can be better understood if we look at the factor-price-dual of GDP, namely wages, land rents and the user cost of capital goods, and the commodity-price-dual of trade volumes, namely the domestic terms of trade. Furthermore, the same work has shown that during episodes of dramatic decline in transport costs between trading partners it is essential to document tradable goods' prices in home markets. Even though historical price evidence is far more accessible for rich countries, it is a very big mistake to use price quotes in "world" markets like London, New York or Amsterdam as proxies for prices in Third World markets like Alexandria, Calcutta or Buenos Aires, a standard procedure used in the past by historians and economists alike when confronting the deteriorating-primary-product-price thesis, W. Arthur Lewis, Raoul Prebisch and Hans Singer being the most famous examples. Indeed, this tradition persists today as illustrated by the oft-cited World Bank paper by Enzo Grilli and Maw Yang (1988) which purports to document the "terms of trade of developing countries" since 1900, but which contains instead the relative prices of various primary products quoted in some common "world" market, *not* the terms of trade for each developing country and *not* quoted in its own market. Angus Deaton (1999) does the same in his otherwise superb survey of 20th century African commodity price experience. This seems to be true of all the recent literature on the Prebisch-Singer terms of trade hypothesis (e.g., Ardeni and Wright 1992; Cuddington 1992; Diakosavvas and Scandizzo 1991). Indeed, this literature rarely explores the impact of these price shocks, but rather only asks whether the terms of trade of primary products has deteriorated over the past century.

To make progress on assessing the impact of globalization on the pre-industrial Third World economies prior to 1940, therefore, it is essential first to establish a panel data base documenting Third World relative commodity prices that are country-specific. But before I do so, it might be helpful to survey what we know about the transport revolution in the Third World and its impact on commodity price convergence between it and the European core.

Third World Transport Revolutions and Commodity Price Convergence

Every historian knows the components of the 19th century world-wide transport revolution. Steamships made the most important contribution to improved shipping technology. A regular trans-Atlantic steam service was inaugurated in 1838, but until 1860 steamers mainly carried high-value goods similar to those carried by airplanes today. A series of innovations in subsequent decades changed all that: the screw propeller, the compound engine, steel hulls, bigger size and shorter turn-around time in port all served to produce a spectacular fall in intercontinental transport costs. Furthermore, the opening of the Suez Canal in 1869 halved the distance from London to Bombay and Rangoon, and the Panama Canal in 1914 reduced the distance from New York to Shanghai and Manila. The other major development in transportation was, of course, the railroad, and the growth in railway mileage during the late 19th century was phenomenal. Refrigeration was another technological innovation with major trade implications. Mechanical refrigeration was developed between 1834 and 1861, and by 1870 chilled beef was being transported from the United States to Europe. In 1876, the first refrigerated ship sailed from Argentina to France carrying frozen beef and by the 1880s South American meat, Australian meat, and New Zealand butter were all being exported in large quantities to Europe.

It is important to stress that the transport revolution was not limited to the Atlantic economy. Certainly the Black Sea and the eastern Mediterranean were part of it. Gelina Harlaftis and Vassilis Kardasis (2000) have shown that the decline in freight rates between 1870 and 1914 was just as dramatic on routes involving Black Sea and Egyptian ports as on those involving Atlantic ports, and perhaps even more so. And the railroads had a big impact in Eurasia and Asia too: in the Ukraine, the railroads tied the interior with Odessa and thus with world markets; and, for the first time in recorded history, the railroad served almost to eliminate local famines on the Indian subcontinent by connecting regional grain markets. And while the Suez Canal had a profound impact in connecting Europe with Asia, there were equally dramatic changes taking place within Asia. Until well into the 19th century, distance had isolated Asia from

Europe where, after all, the industrial revolution was unfolding. Late 19th century transport innovations started to change all that, although not completely. The appearance of the Suez Canal, cost-reducing innovations on sea-going transport, and railroads penetrating the interior did not completely liberate Asia from the tyranny of distance by 1914. But it was the change in the economic distance to the European core which mattered to the Asian periphery, even though the levels remained high well in to this century. The tramp charter rate for shipping rice from Rangoon to Europe, for example, fell from 73.8 to 18.1 percent of the Rangoon price between 1882 and 1914. The freight rate on sugar between Java and Amsterdam fell by 50 or 60 percent between 1870 and World War I. The freight rate on coal between Nagasaki and Shanghai fell by 76 percent between 1880 and 1910, and total factor productivity on Japan's tramp freighter routes serving Asia advanced at 2.5 percent per annum in the thirty years between 1879 and 1909 (Yasuba 1978, Tables 1 and 5).

Perhaps the greatest 19th century globalization shock in Asia did not involve transport revolutions at all. Under the persuasion of Commodore Perry’s American gun ships, Japan signed the Shimoda and Harris treaties with the United States and in so doing switched from virtual autarky to free trade in 1858 (Howe 1996: Chp. 3). It is hard to imagine a more dramatic switch from closed to open trade policy, even by the standards of the recent Asian miracle. In the fifteen years following 1858, Japan's foreign trade rose from nil to 7 percent of national income (Huber 1971). I shall have more to say about the implications of this political event in Section 4, but note that other Asian nations followed this liberal path, most forced to do so by colonial dominance or gunboat diplomacy. Thus, at the end of the Opium Wars, China signed a treaty with Britain in 1842 which opened her ports to trade and which set a 5 percent *ad valorem* tariff limit. Siam avoided China’s humiliation by going open and adopting a 3 percent tariff limit in 1855. Korea emerged from its autarkic Hermit Kingdom about the same time, undergoing market integration with Japan long before colonial status became formalized in 1910. India went the way of British free trade in 1846, and Indonesia mimicked Dutch liberalism. In short, after the late 1850s commodity price convergence in

Asia was driven entirely by sharply declining transport costs with no rise in tariffs to offset that commodity price convergence force. Asia's commitment to globalization, forced or not, started more than a century ago.

What was the impact of these transport innovations on the cost of moving goods between markets? The decline in international transport costs after mid-century was enormous, and it ushered in a new era. When economists look at this period, they tend to focus exclusively on tariffs and trade volumes. This is a big mistake. Being endogenous and determined by many factors, the volume of trade is an unsatisfactory index of commodity market integration: it is the costs of moving goods between markets and relative commodity prices that count. So, what about commodity price convergence?

Trend estimates based on Knick Harley's (1980) annual data show that Liverpool wheat prices exceeded Chicago prices by 57.6 percent in 1870, by 17.8 percent in 1895, and by 15.6 percent in 1912. Both the Liverpool-New York and New York-Chicago price gaps declined steeply. Moreover, these estimates understate the size of the price convergence because they ignore the collapse in price gaps between Midwestern farm-gates and Chicago markets (as well as between Liverpool and British consumers living inland). This price convergence experience in Anglo-American wheat markets was repeated for other foodstuffs. The second biggest tradable foodstuff consisted of meat and animal fats such as beef, pork, mutton and butter. While there was no convergence in London-Cincinnati price differentials for bacon across the 1870s, there was convergence after 1880. Indeed, the price convergence after 1895 was even more dramatic for meat than it was for wheat: price gaps were 92.5 percent in 1870, still 92.3 percent in 1895, but only 17.9 percent in 1913. The delay in price convergence for meat, butter and cheese has an easy explanation: it required the advances in refrigeration made towards the end of the century.

Anglo-American price data are also available for many other non-agricultural commodities (O'Rourke and Williamson 1994). The Philadelphia-London iron bar price gap fell from 75 percent in 1870 to 20.6 percent in 1913, the pig iron price gap fell from 85.2 to 19.3 percent, and the copper price gap fell from 32.7 to almost zero; the Boston-London hides price gap fell from 27.7 to 8.7 percent, and the wool price gap fell from 59.1 to 27.9 percent; finally, the Boston-Manchester cotton textile price gap fell from 13.7 percent to about zero. Commodity price convergence can also be documented for coal, tin and coffee. Furthermore, similar trends can be documented for price gaps between London and Buenos Aires, Montevideo and Rio de Janeiro (Williamson 1999b). Commodity price convergence also involved the European continent. Denmark was a free-trader throughout this period, and there was Danish price convergence on America equal to that of Britain. The Ukraine and the rest of the east European periphery was also part of this world-wide price convergence: wheat price gaps between Odessa and Liverpool of about 40 percent in 1870 had just about evaporated by 1906 (O'Rourke 1997).

Transport cost declines from interior to port and from port to Europe also ensured that Asian economies became more integrated into world markets. Price gaps between Britain and Asia were driven down by the completion of the Suez Canal, by the switch from sail to steam, and by other productivity advances on long distance sea lanes. The cotton price spread between Liverpool and Bombay fell from 57 percent in 1873 to 20 percent in 1913, and the jute price spread between London and Calcutta fell from 35 to 4 percent (Collins 1996, Table 4). The same events were taking place even farther east, involving Burma and the rest of Southeast Asia. Indeed, the rice price spread between London and Rangoon fell from 93 to 26 percent in the four decades prior to 1913 (Collins 1996, Table 4). These events had a profound impact on the creation of an Asian market for wheat and rice, and, even more, on the creation of a truly global market for grains (Latham and Neal 1983; Brandt 1985; Kang and Cha 1996). Finally, the impact of transport revolutions on commodity price convergence involving the eastern Mediterranean was just as powerful. The price spread on Egyptian cotton between Liverpool and Alexandria markets plunged off a high plateau after the 1860s. The average percent by which Liverpool price quotes exceeded those in Alexandria was: 1837-1846 63.2; 1863-1867 40.8; 1882-1889 14.7 and 1890-1899 5.3 (Issawi 1966, pp. 447-8).

All of this is summarized in Table 1 which also adds an attempt to quantify the magnitudes of the transport revolution over the century or so between 1870 and 1990. Note there are four Addenda inserted, each offering an estimate of the impact of declining transport costs – restricted to seaborne freight – on the price gap between sending and receiving regions. The "representative" commodity is grain, and the estimated decline in the freight rate index is applied to the initial production cost of grain at the beginning of each period to get an estimate of the percentage points per decade by which the ratio of freight costs to production costs declined. There are many assumptions lurking behind the estimates,[2] but they confirm the premise that the spectacular pre-World War I decline in transport costs -- which was bigger in Asia -- slowed down a bit during the interwar decades, and that transport costs have declined only modestly since 1950.

[Table 1 about here]

So, what did the pre-1940 world-wide commodity price convergence imply for the terms of trade in the Third World?

New Evidence: Third World Terms of Trade Trends Before 1940

Appendix Tables 1 and 2 report terms of trade estimates averaged over half-decades where 1911=100.[3] All of these estimates are constructed from price quotes in home markets, and all are aggregated up using country-specific trade, production or consumption weights. <u>Pa</u> refers to agricultural products (not restricted to food), <u>Pm</u> refers to manufactured goods, <u>Pexp</u> refers to exports and <u>Pimp</u> to

[2] One obvious assumption is that the weights are fixed: that is, I take grains like wheat and rice as the representative commodities throughout. Yet, grain has declined as a share in total world trade, and manufactures have risen. Manufactures have always had far lower freight cost/ production cost ratios, and thus the same changes in freight rates are likely to have had a smaller impact on overall commodity price gaps in the 1980s than in the 1880s.

[3] These terms of trade data are still undergoing revision, and thus they should be viewed as provisional. The sample is also being expanded from the 19 reported here, a number limited in this paper by the availability of the factor price data.

imports. Thus, Appendix Table 1 offers a time series on the domestic terms of trade facing agriculture while Appendix Table 2 offers another on the external terms of trade facing each country in the sample. The country-specific evidence in both of these appendix tables is summarized at the regional level in Table 2.

[Table 2 about here]

What do I expect to find? *If* commodity price convergence was the only force at work up to World War I, I would expect Pexp/Pimp to improve for all countries: after all, commodity price convergence serves to raise the price of exportables and lower the price of importables for all trading partners. And *if* commodity price convergence was the only force at work up to World War I, I would expect Pa/Pm to improve for all land-abundant economies which specialized in "agriculture" while I would expect it to deteriorate for all land-scarce economies which specialized in "manufactures."[4] I also expect these terms of trade effects to have been bigger in the Third World where the transport revolution seems to have been bigger and, for Pa/Pm at least, where it was not offset by more protective tariffs. These predictions are qualified by the *ceteris paribus* "if": after all, there were world supply and demand forces at work which would also have influenced relative price trends.

Even though these predictions were qualified, they seem to be confirmed: (1) Pa/Pm rose more in the land-abundant periphery; (2) Pexp/Pimp rose pretty much everywhere before World War I; (3) Pexp/Pimp rose more in land abundant than in land scarce regions; and (4) both Pa/Pm and Pexp/Pimp rose more in the land-abundant Third World than in the land-abundant New World. Let me elaborate on each of these findings.

First, Pa/Pm rose more in the land-abundant periphery than in the land-scarce center. From

[4] In a future paper, I hope to be able to sort out how much of each country's Pa/Pm and Pexp/Pimp movements are due to changes in transport cost and policy abroad, and how much to changes in "world" market conditions, like growth slowdown plus income and price elasticities, the latter the prime suspects in the Singer-Prebisch terms of trade deterioration debate.

the early 1870s to World War I, Pa/Pm increased by 20.5 percent in land-scarce Europe and by 14.4 percent in land-scarce East Asia, for an average of 19.7 percent. The figures are bigger for the land-abundant periphery. For the same period, the Pa/Pm increased by 22.2 percent in the New World (with Argentina and Uruguay) and by 27.2 percent for the Third World (without Argentina and Uruguay), for an average of 24.2 percent. From the early 1890s to World War I, the figure is 12 percent for the land-scarce regions and 27 percent for the land-abundant regions. Figure 1 illustrates this contrast showing the pre-World War I rise in Pa/Pm for land-abundant Egypt, Uruguay and Thailand against the stable or falling Pa/Pm for land-scarce Great Britain.

[Figure 1 about here]

Second, and with only one exception, the terms of trade improved for all trading regions. These contrasting Pa/Pm trends in land-abundant and land-scarce parts of the world are consistent with Pexp/Pimp rising everywhere. Appendix Table 2 reports only one exception to this rule: Pexp/Pimp fell in Germany, although it is true that Pexp/Pimp also showed little trend in France, Japan, Spain or Taiwan. The regional aggregates in Table 2 illustrate the point more sharply. From the early 1870s to World War I, the terms of trade rose everywhere. From the early 1890s to World War I, the terms of trade rose everywhere except in the land-scarce Third World, that is, in East Asia.

Third, Pexp/Pimp and Pa/Pm rose by more in land-abundant regions than in land-scarce regions. From the early 1890s to World War I: the average changes in Pa/Pm were 27 percent vs 12 percent in land-abundant vs land-scarce countries, respectively; and the average changes in Pexp/Pimp were 17.6 percent vs -3.9 percent, respectively. From the early 1870s to World War I: the figures for Pa/Pm were 24.2 percent vs 19.7 percent, while they were 37.1 percent vs 3.4 percent for Pexp/Pimp. Clearly, the land-abundant periphery was confronted with far more favorable price shocks prior to World War I than was the land-scarce and industrializing center.

Fourth, Pexp/Pimp and Pa/Pm rose by more in the land-abundant Third World than in the

land-abundant New World. Again, the regional averages in Table 2 illustrate the point, although how one categorizes the Southern Cone matters. With Argentina and Uruguay allocated to the Third World group, consider its performance between the early 1870s and World War I: Pa/Pm rose by 40.5 percent in the land-abundant Third World compared with no rise at all in the land-abundant New World (-0.2 percent). The figures for Pexp/Pimp are 48.5 percent compared with 25.7 percent. With Argentina and Uruguay again allocated to the Third World group, consider its performance between the early 1890s and World War I: Pa/Pm rose by 31.6 percent in the land-abundant Third World compared with 17.7 percent in the land-abundant New World. The comparative figures for Pexp/Pimp are 21.1 percent and 10.7 percent. To summarize, commodity price convergence up to World War I caused a predictable convergence in Pa/Pm between land-scarce and land-abundant countries the world around, and the boom in Pa/Pm in the land-abundant parts of Latin America, the eastern Mediterranean and Asia was considerably bigger than in North America and Australasia.

There was a dramatic regime switch in relative price trends after World War I, partly because the transport revolution slowed down (Table 1), and partly because of the retreat towards autarky in what we now call the OECD and in Latin America. Both forces would have served to cause a slowdown or perhaps even a reversal in commodity price convergence. Furthermore, the retardation in world growth[5] must also have twisted the fundamentals underlying all commodity markets in ways that might account for the regime switch. Thus, Pa/Pm collapsed in all regions after World War I (Table 2), although it collapsed by more in land-abundant regions, two events which provoked Raoul Prebisch, Hans Singer, Ragnar Nurkse, Gunnar Myrdal and W. Arthur Lewis to infer that the primary product boom was over and that an epoch of deterioration had set in, an event that they thought warranted the pro-industry intervention, a policy stance that stuck until the move back towards openness started in the 1970s. Furthermore, Table 2 shows just how

[5] Maddison (1995: Table 3-1, p. 60) reports “world” GDP per annum growth (in percent) of: 1820-1870, 1; 1870-1913, 2.1; 1913-1950, 1.9; and 1950-1973, 4.9.

spectacular the regime switch was for the land-abundant parts of the world. In the land-abundant Third World (with Argentina and Uruguay), the difference between the interwar change in Pa/Pm (-9.1 percent) and the prewar change (+31.6 percent) implies a decline in 40.7 percentage points, a huge decline for a relative price. The decline in the land-abundant New World (without Argentina and Uruguay) is 32.2 percentage points, not as big as the land-abundant Third World, but a very big relative price decline nonetheless. The Pa/Pm regime switch was smaller for land-scarce regions, especially Europe, and this was even more true for Pexp/Pimp. The Pexp/Pimp regime switch by region was the following: land-scarce Europe +10.2; land-scarce East Asia -4.7 percent; land-abundant New World (without Argentina and Uruguay) -2.9 percent; and land-abundant Third World (with Argentina and Uruguay) -25.1 percent. Appendix Table 2 shows which countries in the center gained and which countries in the periphery lost from that regime switch.

3. Trade Theory

What was the impact of commodity price convergence and the price shocks it generated for the Third World prior to 1940? The list of effects is long and W. Arthur Lewis played an important part in writing it (Lewis 1954, 1970, 1978a, 1978b). The list includes: the response of international capital flows (Green and Urquhart 1976; Edelstein 1982; O'Rourke and Williamson 1999a, Chps. 11 and 12); the response of international labor migrations and land settlement (Findlay 1995; Hatton and Williamson 1998); and the impact of the price shocks on de-industrialization everywhere around the periphery (Bairoch 1982; Lewis 1978a), as primary-product export sectors boomed and import-competing sectors, like textiles, slumped.[6] The list also includes the impact of the price shocks on income distribution. This

[6] In the near future, I hope to explore these other two issues at length: the impact of commodity price convergence in the Third World periphery on across-the-border factor migration and de-industrialization.

paper focuses on income distribution as manifested by factor prices. Furthermore, it is the wage-rental ratio -- the returns to labor relative to land -- that interests me most. Ever since Eli Heckscher and Bertil Ohlin wrote about the problem almost a century ago (Flam and Flanders 1991), commodity price convergence has been associated with relative factor price convergence. That is, if Pa/Pm converges between trading partners, the wage-rental ratio, w/r, should also converge: it should fall in the land-abundant and labor-scarce country (since the export boom raises the relative demand for the abundant factor, land) and it should rise in the labor-abundant and land-scarce country (since the export boom raises the relative demand for the abundant factor, labor). Where land was held by the favored few and where industrialization had not yet taken hold, the pre-World War I commodity price convergence implied greater inequality in resource-abundant economies like those in Southeast Asia, the Southern Cone, Egypt and the Punjab. It also implied lesser inequality in resource-scarce economies like those in western Europe and East Asia.[7] Of course, in those places where the family farm dominated and where land was distributed more equally, a fall in w/r would not have translated into such a sharp rise in inequality.

Note that I have been talking about *relative* factor prices, not *absolute* factor prices. I have said nothing about real wages, real incomes and living standards. While price shocks can certainly have an impact on real wage levels, in the long run they are driven upward almost entirely by technological advance, capital-deepening and human capital improvement. In most of the Third World before 1940, these forces were modest enough to ignore. This fact should help motivate our focus here on *relative* factor prices, or what I am calling income distribution. To repeat: ***history confirms that relative factor price convergence took place world-wide while absolute factor price divergence was dramatic***.

My central concern, then, is the connection between Pa/Pm and w/r. Section 4 will document pre-

[7] Using Raymond Goldsmith's estimates, Peter Lindert (1988: Figure 1) reports the share of agricultural land in tangible national wealth around 1900 to be (in percent): Britain 10; the United States 19; France 30; Japan 30; and Mexico 22. Around 1850, the shares were much bigger: Britain 25; the United States 35; Japan 35; and France 50. Presumably, the shares were even bigger in the (undocumented) pre-industrial periphery.

1940 w/r evidence for our sample of nineteen countries, but first we need to sharpen the theory. I lean heavily here on the three-factor (land, labor, capital) and three-good (one agricultural and two manufactured) model of Max Corden and Fred Gruen (1970), Michael Mussa's (1979) dual exposition for the two-sector model, Douglas Irwin's (1999) extension of the Mussa framework to the three-good case, and the magnification effect identified by Ronald Jones (1979).

Irwin's Figure 2 is reproduced here.[8] The right quadrant depicts the two manufactured goods (1 and 2), and the left the agricultural good (A). The shape of the isoprice curves are dictated by the elasticity of factor substitution; the curvature of Pa determined by the elasticity of substitution between land (its price r) and labor (its price w) and that of P1 and P2 determined by the elasticity of substitution between labor and capital (its price i). The isoprice curve for the agricultural sector, Pa(w,r), is the dual of agricultural production whose output is constrained by the immobile factor, land, and the mobile factor, labor. The isoprice curves of the two manufactured goods, P1(w,i) and P2(w,i), are drawn to conform to the assumption that good 1 is more labor-intensive than good 2. If the prices of all three goods are determined by external forces -- transport costs to foreign markets, conditions in those markets, and trade policy, then the equilibrium wage is determined at the intersection of the isoprice curves in the manufacturing sector.

[Figure 2 about here]

The model is simple, but it isolates what should be important. An increase in the price of the labor-intensive manufactured good shifts its isoprice curve to P1'. Wages rise, and since land rents fall (labor is pulled off the land), the wage-rental ratio rises even more. Furthermore, here we get our first evidence of a magnification effect since the rise in w exceeds the rise in P1. In contrast, if P1 falls (relative to both P2 and Pa), w falls, r rises, and w/r rises still more. Suppose the relative prices of P1 and P2 stay the same, Pm (a weighted average of P1 and P2) stays the same, but Pa/Pm rises: Pa(w,r) shifts outward to the left, r

[8] The next two paragraphs draw heavily on Irwin (1999: 6-10).

rises, while w stays the same. In this example of a favorable price shock to the land-abundant country specializing in agriculture, w/r falls, and there is a magnification effect since the rise in r exceeds the rise in Pa. By symmetry, when Pa/Pm falls, w/r rises, again by a magnification effect.

How big is the magnification effect? It depends, as Ronald Jones (1979) shows in his classic paper on the two-sector model with three factors, one of which is sector-specific. Suppose we have an agricultural sector that uses mobile labor, earning the wage w as before, and immobile land, earning the rent r as before. Suppose further we have a manufacturing sector that uses mobile labor and immobile capital, earning an interest rate i. Now, shock this economy by a rise in Pa/Pm. It must follow that

$$r^* > Pa^* > w^* > Pm^* > i^*,$$

where the "*" refers to rates of change, and where it is clear that the changes in the returns to the specific factors are more pronounced than the return to the mobile factor (Jones 1979: 90): after all, while a mobile factor can escape a sector absorbing a bad price shock, an immobile sector-specific factor cannot. Furthermore, the inverse of the wage-rental ratio responds as

$$(r^* - w^*) = \Delta\,(Pa^* - Pm^*)$$

where $\Delta > 1$ denotes the magnification effect. This magnification effect should vary from country to country, depending on the size of agriculture and the character of technologies in all sectors. Thus, globalization shocks can have different effects on wage-rental ratios depending on their size and the structure of the economy in question, but the expectation is that $\Delta > 1$ everywhere.

Changes in the land-labor ratio can be treated in much the same way. Still using the simple two-sector model, the inverse of the wage-rental ratio responds to changes in the land-labor ratio as

$$(r^* - w^*) = \mu\,(L^* - D^*)$$

where L is labor, D is land, and μ denotes the economy-wide response of relative factor prices to changes in endowments. The response, μ, is conditioned by the composite of sectoral substitution elasticities, sectoral factor income shares and initial factor distributions between sectors; and, in contrast with Δ, theory does not tell us more than simply that $\mu > 0$. Even if technologies were identical across countries, the size of μ would still vary according to comparative advantage, specialization and, thus, output mix.

For the pre-industrial Third World, these are likely to be the essentials driving factor prices. For the greater Atlantic economy (and perhaps for Japan), capital-deepening and rapid productivity advance in urban-based manufacturing must be added to include the powerful effects of industrialization which pulls labor off the land and raises the wage-rental ratio, forces which the literature has already identified as very important (O'Rourke, Taylor and Williamson 1996).

4. Relative Factor Price Convergence: Third World Wage-Rent Trends Before 1940

The move to free trade in much of Asia, plus the revolutionary decline in transport costs everywhere in the Third World, steadily eroded, as we have seen, price gaps between the European core and the periphery in the half-century before 1914. It probably eroded them even more *within* the periphery, since there was far less globalization backlash there. As we have also seen, prices of exportables boomed in the exporting countries. Price trends reversed after World War I, but on either side of that great divide one would have thought that the relative rewards to land and labor should have been dramatically affected. Exactly how they were affected should have depended, of course, on whether the abundant factor was land -- as in Argentina and Thailand, or labor -- as in Ireland and Japan. Consider the canonical land-scarce and labor-abundant case, Japan. When Japan emerged from isolation after 1858, prices of its labor-intensive exportables soared, rising towards world market levels, while prices of its land and machine-and-land-intensive importables slumped, falling towards world market levels: one researcher estimates that the terms of trade rose by a factor of 3.5 over the fifteen years following 1858 (Huber 1971), while another thinks the figure was 4.9 (Yasuba 1996, p. 548). The Heckscher-Ohlin model predicts that the abundant factor (labor) should have flourished while the scarce factor (land) should have languished over the fifteen years or so following 1858. Did they?

The available factor price evidence for Japan in mid-century is limited. Table 4 confirms that data on land rents or land values are not available until 1885, long after Japan's leap to openness had taken place. But we do have some crude evidence, and it seems to confirm the Heckscher and Ohlin hypothesis. Angus Maddison (1995: 196) estimates that the total (not per annum) increase in real GDP per capita was only 5.3 percent between 1820 and 1870. Assume that all of that increase took place between 1850 and 1870, an unlikely event that argues against the thesis. J. Richard Huber (1971) estimates that the real wage for unskilled workers in Osaka and Tokyo increased by 67 percent in this period. True, this huge increase is much bigger than the real wage growth I have estimated; in my data we would have to go back to the late 1830s to find a real wage increase between then and 1870 anything like that estimated by Huber (about 63 percent: Williamson 1999a). Nevertheless, consider the implication of Huber's estimates: the wage of unskilled labor, the abundant factor, increased by 43 percent relative to average incomes in Japan. Under plausible assumptions,[9] this implies that land rents fell by more than 80 percent in Japan. Thus, the wage-rental ratio rose by more than 7.3 times (from 1.0 to 1.67/0.20)! To repeat, this is exactly what one would have predicted when a technologically quiescent economy is hit with a huge price shock which favors the exportable and disfavors the importable: in a land-scarce economy like pre-industrial Japan, the wage-

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[9] The arithmetic is trivial. Let national income (Y) equal the sum of wages (wL, the wage per worker times the total labor force) and land rents (rD, rent per hectare times total hectares), and ignore skills, capital and all else: Y = wL + rD. Then per worker income growth is (where an "*" refers to the percentage growth over the full fifteen years):

$$Y^*-L^* = w^*\theta_w + L^*(\theta_w-1) + r^*\theta_r.$$

I assume that labor (θw) and land's (θr) share exhausted national income, and that labor got 60 percent. I also assume that land hectarage was fixed, and that labor force growth (assumed equal to population growth) was 7.6 percent between 1850 and 1870 (Maddison 1995: 106). If some of the GDP per capita growth between 1820 and 1870 actually took place before 1850, then land rents fell by even more than what I guess here. This calculation is taken from O'Rourke and Williamson (1999a: Chp. 4).

rental ratio *should* have soared, with obvious distributional (and, one supposes, political) implications.

Is a rise in the wage-rental ratio of 7.3 times too big to be believed? Not according to the magnification effect coming from trade theory discussed in the previous section. Let Pm be the price of labor-intensive manufacturing exportables, Pa the price of land-intensive importables, w the wage rate, r the rent on a hectare of land, and $0<(1-\theta wj)=\theta rj<1$ the share of factor payments in sector j going to land rents. Land is far more important in agriculture than in manufacturing, so $1/(\theta ra - \theta rm) > 1$, and thus the impact of a relative price shock (Pm* - Pa*) has a magnification effect on relative factor prices (w* - r*):[10]

$$(Pm^* - Pa^*)/(\theta ra - \theta rm) = (w^* - r^*).$$

If the land share was about 0.4 in agriculture and very small in manufacturing, the magnification effect would be close to 2.5. Thus, a rise in Pm/Pa by 3.5 times could easily have induced a rise in w/r by 7.3 times, *ceteris paribus*.

These are only informed guesses, of course, but Table 4 reports the real thing. Wage-rental ratio trends can be constructed for Japan starting 1885, Korea starting 1909 and Taiwan starting 1904. In contrast with the Punjab after 1873 or Japan after 1858, the early 20th century was not a period of technological quiescence in East Asian agriculture. Instead, the region was undergoing land-saving and labor-using innovation (Hayami and Ruttan 1971), forces which should have served by themselves to raise the wage-rental ratio. It was also a period of dramatic industrialization, at least in Japan, which served to pull labor off the farms (Brandt 1993), another force serving to raise the wage-rental ratio. The period after 1910-1914 was also one of unfavorable farm price shocks (Kimura 1993; Kang and Cha 1996), yet another force serving to raise the wage-rental ratio. In short, we might expect those wage-rental ratio trends for Japan, initiated by globalization forces in the mid-19th century, to have continued everywhere in East Asia in the 20th century. That is exactly what Table 4 shows: East Asian wage-rental ratios surged up to the 1920s and 1930s. Indeed, land-scarce Europe experienced the same surge in wage-rental ratios during the

[10] See Jones (1979: 60).

so-called grain invasion after the 1870s, at least where trade policy remained liberal (O'Rourke, Taylor and Williamson 1996). Furthermore, the magnitudes were not so different. Between 1910/14 and 1925/29, the wage-rental ratio rose by 88 percent in Japan, by 72 percent in Korea, and by 40 percent in Taiwan (Table 4). The average increase in the wage-rental ratio for Britain, Ireland, Denmark and Sweden was 27 percent between 1890/04 and 1910/14, and 50 percent between 1875/79 and 1890/94 (Table 3). It might also be relevant to add that politically powerful landed interests were able to secure some protection from these globalization forces in both continental Europe with tariffs on grain (O'Rourke 1997; Williamson 1997), so that the wage-rental ratio rose only about a third as fast in the average of France, Germany and Spain compared with the open four of Britain, Ireland, Denmark and Sweden (Table 3). Japan achieved much the same with import restrictions on rice (Brandt 1993).

[Tables 3 and 4 about here]

In contrast with East Asia and Europe, I take the Punjab to have been relatively land abundant, an assumption that seems to be confirmed by the fact that agricultural exports from the Punjab to Europe boomed after the early 1870s, while irrigation investment and new settlement made it behave like a frontier region.[11] Globalization should have had the opposite effect on the wage-rental ratio in land-abundant Punjab compared with land-scarce Japan: it should have fallen, and fall it did. Between 1875/79 and 1910/14, the wage-rental ratio in the Punjab fell by 60 percent. The Punjab's wage-rental ratio experience was not so different from that of the Latin American Southern Cone and other parts of the New World. Between 1870/74 and 1910/14, the wage-rental ratio fell by 69 percent in the combined pair of Australia and the United States (Table 3), and between 1880/84 and 1910/14 it fell by 85 percent in the combined pair of Argentina and Uruguay (Table 4). Egypt, riding a cotton boom, conformed to these Asian and Latin American trends: from the late 1870s to 1910/14, the Egyptian wage-rental ratio fell by 54 percent, and

[11]It is relative endowments that count for specialization and trade. Presumably, both labor and land had low productivity in the Punjab compared with Western Europe. The effective stocks of labor and land were both very low.

from the late 1880s it fell by 85 percent (Table 4).

The recorded collapse in wage/rental ratios in the land-abundant Southern Cone, the Punjab and Egypt prior to World War I is simply enormous. When compared with the upward surge in wage/rental ratios in land-scarce Europe and East Asia, these trends imply very powerful relative factor price convergence world wide. But they were even more powerful elsewhere. The best examples of factor price convergence in land-abundant and labor-scarce economies can be found in rice-exporting Southeast Asia. Table 4 documents wage-rental ratio trends there for two countries, Burma and Siam. Pre-1914 globalization shocks served to lower the wage-rental ratio in both places, and the decline was huge. The Burmese ratio fell by 44 percent over the twenty years between 1890/94 and 1910/14, while the Siamese ratio fell by 92 percent over the same period, and by 98 percent between 1870/74 and 1910/14! These are even bigger wage-rental ratio declines than those recorded in the Southern Cone, Australia or North America.

With the collaboration of Alan Taylor and Kevin O'Rourke, I have already shown how relative factor price convergence took place in the Atlantic economy over the four decades or so following 1870 (O'Rourke, Taylor and Williamson 1996). These factor price convergence trends are reproduced in Table 3, where new evidence for the interwar period and new evidence for Uruguay (Table 4) join revisions of the rest, yielding for the decades prior to about 1940 data for: five land-abundant overseas settlements – Argentina, Australia, Canada, Uruguay and the United States; four land-scarce European countries that pretty much stuck to free trade – Denmark (data only to 1913), Great Britain, Ireland and Sweden (data only to 1930); and three land-scarce European countries that raised tariffs to help fend off the winds of competition – France, Germany (data only to 1913) and Spain (data only to 1934). As I have already noted above, the wage-rental ratio collapsed in the land-abundant New World, and it surged in the land-scarce Old World. Land-scarce European countries that were less committed to the globalization game -- raising tariffs to fend off foreign competition -- underwent a less dramatic increase in their wage-rental ratio.

While there is certainly no evidence of factor price equalization anywhere in the Atlantic economy during this century of globalization, Table 3 offers overwhelming evidence of relative factor price convergence, at least up to the eve of World War I.

What happened after 1914 when so many countries in the Atlantic economy retreated behind tariff walls, underwent competitive devaluations, restricted migrations, and used other devices to try to move back towards their pre-1800 autarkic roots? Ubiquitous (relative) factor price convergence ceased, and in many cases divergence set in. The pre-1914 downward trends in the wage-rental ratio in land-abundant Australia, Canada and the United States turned around and rose to 1935/39. The same was true of land-abundant Argentina, Uruguay, Egypt, Burma, and Siam (although it was not true of the Punjab, and some countries underwent a far more spectacular reversal than others). The pre-1914 wage-rental ratio surge in land-scarce Europe and East Asia did not, however, reverse after 1914, but it does look like it slowed down.

The factor-price-convergence theorem seems to have been alive and well in the world economy before World War I: the wage-rental ratio rose in labor-abundant and land-scarce trading partners while it fell in land-abundant and labor-scarce trading partners, and Asia and the Middle East joined the European economy and its overseas settlements in those trends. Figure 3 summarizes this process by plotting the enormous fall up to World War I in the wage-rental ratio for Egypt, Thailand and Uruguay compared with the slow rise in the ratio for Great Britain. Thus far, however, I have not been very precise in making the empirical connection between commodity price convergence and factor price convergence; nor have I established causality unambiguously; nor have I said much about changing land-labor ratios, industrialization, and factor-saving technological change; nor have I established whether and to what extent the Third World was different. The next section will expand in all of these directions.

[Figure 3 about here]

5. Explaining Relative Factor Price Convergence: Determinants of Wage/Rent Trends 1870-1940

What explains the various trends in wage-rental ratios documented in Tables 3 and 4? The theory reviewed in Section 3 suggests four forces. First, there are the forces of globalization, measured here by changes in the relative price of agricultural goods, Pa/Pm. Section 3 argued that the impact of Pa/Pm should vary across economies, the size of the impact correlated negatively with the level of development and positively with the size of the agricultural sector. To accommodate this possibility, we will estimate independently these country-specific forces within four regional groups: the land-abundant New World; land-scarce Europe; the land-scarce Third World; and the land-abundant Third World. Second, trends in the land/labor ratio should matter, and these endowment trends exhibit considerable variety over time and space (Appendix Table 3 and Figure 4).[12] Third, capital-deepening in the non-farm sector should draw labor off the land and raise the wage-rental ratio. Fourth, there is factor-saving technological change to consider. While these technological forces were likely to have been very weak in the pre-industrial Third World, they were likely to have been very strong in industrializing Europe, North America, Australia, and Japan. Earlier work on the greater Atlantic economy (O'Rourke, Taylor and Williamson 1996: Table 3) has shown that the land-saving technological change which characterized land-scarce Europe made a powerful contribution to rising wage-rental ratios there,[13] and it also showed that the labor-saving technological change which characterized labor-scarce North America and Australia made a powerful contribution to falling wage-rental ratios there.

[Figure 4 about here]

Unfortunately, causality problems and inadequate data will both complicate the empirical

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[12]These land/labor ratios are still being revised and thus they should be viewed as preliminary estimates only.

[13] As I mentioned only briefly above, research by Hayami and Ruttan (1971) established thirty years ago the powerful land-saving forces at work in East Asia prior to 1940.

assessment. Pre-1940 Third World capital stock data are missing, so we must rely on crude proxies for the absent capital-labor ratios. Missing too are measures of total factor productivity growth. Thus, it will be impossible to control for these two forces adequately in what follows. In contrast, O'Rourke, Taylor and Williamson (1996) were able to do so for the better-documented greater Atlantic economy. To make possible comparisons between the Third World and the Atlantic economy, I have had to replace productivity and capital-labor variables with a crude proxy, the share of the population urban.[14] Empirical problems are made worse by problems of causality. In a closed economy, an exogenous rise in the land-labor ratio will raise the wage-rental ratio and lower Pa/Pm. In an open economy, where Pa/Pm is more likely to be exogenous, a rise in the land-labor ratio can still help raise the wage-rental ratio. But are we sure that factor endowments are exogenous? High and rising wage-rental ratios are likely to generate a factor supply response. The land-labor ratio may decline in the long run as positive Malthusian forces associated with labor scarcity encourage early marriage, high fertility in marriage, and high child survival rates. Labor scarcity may also encourage across-border migration and thus an even greater and quicker decline in the land/labor ratio. Alternatively, high and rising wage-rental ratios may foster land settlement, frontier experience that has received considerable theoretical and empirical attention in the literature (Findlay 1995; O'Rourke and Williamson 1999a). So, what should we expect? A positive or a negative sign on land-labor ratios in the reduced-form regressions explaining wage-rental ratios? We cannot be sure until causality issues are resolved, and these might well differ between regions. In spite of these expected complications, I plunge on.

First Pass: Ordinary Least Squares

I postpone the cointegration analysis, and start first with ordinary least squares (OLS) estimation.

[14] Replacing the urbanization proxy with time trends does nothing to change the results reported here. I am still searching for better proxies since urbanization is obviously endogenous with respect to Pa/Pm, at least to the extent that non-agricultural activities (m) are urban.

Table 5 reports OLS with fixed effects for all 19 countries (1055 observations), and for each of the four regions separately: the land-abundant New World (308 observations, 29 percent of the sample) -- Argentina, Australia, Canada, Uruguay and the United States; land-scarce Europe (404 observations, 38 percent of the sample) -- Great Britain, Denmark, France, Germany, Ireland, Spain and Sweden; land-abundant Asia and the Middle East (226 observations, 22 percent of the sample) -- Burma, Egypt, the Punjab and Thailand; and land-scarce Asia (117 observations, 11 percent of the sample) – Japan, Korea and Taiwan. Fixed effect estimation is required since Pa/Pm, w/r and land/labor are all indexed at 1911 or 1913, so cross country variance in any year has no meaning. All variables are in natural logarithms.

[Table 5 about here]

Let's start with the good news. As theory predicts, the impact of Pa/Pm is everywhere negative and significant: a boom in the relative price of agricultural goods raised the rent on land relative to the wage for labor; a slump had the opposite effect. Furthermore, and again as theory predicts, the impact was far bigger in the land-abundant regions where agriculture played a far bigger role: the coefficient on Pa/Pm is 1.3 times bigger in the New World than in Europe and 5.6 times bigger in land-abundant Asia than in land-scarce Asia. Thus, there are indeed two reasons why globalization had such a big impact on income distribution in the Middle East, South Asia and Southeast Asia, and such a small impact in Europe: the Pa/Pm shocks *and* the magnification effects were smaller in Europe. The surprise, however, is that the oft-cited "magnification effect" is absent from Table 5 except for land-abundant Asia: that is, in only one case are the coefficients in the first row of Table 5 greater than unity (land-abundant Asia, -1.28). As we shall see in a moment, the modified regression equations in Table 6 report somewhat higher coefficients on Pa/Pm, but even there the magnification effect is shown to have been present in less than half of the pre-1940 global economy.

Next, consider the urbanization proxy. To the extent that this is an index of capital-deepening and total factor productivity advance in industrial and service sectors, rising urbanization rates should have been associated with the strong pull of labor off the land, and thus with rising wage/rental ratios. Urbanization should have a positive coefficient, at least where we have reason to believe industrial revolutionary events were taking hold, and these were primarily in land scarce parts of the world. With one exception, Table 5 confirms this prediction. The coefficient on urbanization is positive and significant for the full sample, for industrial Europe and for industrializing land-scarce East Asia. Furthermore, the coefficient is insignificant for land-abundant Asia, a region where we have reason to believe that none of the capital-deepening and technologically-improving forces of modern economic growth were at work. The exception appears to be the New World, a land abundant region where industrialization was rapid: here urbanization is significantly associated with *falling*, not rising, wage/rental ratios. This exception could be rationalized by an appeal to the finding by O'Rourke, Taylor and Williamson (1996) of strong labor-saving technological change in the New World.

At first sight, the disappointing result in Table 5 might be the estimated impact of the land/land ratio. Here we were expecting a positive coefficient, more land per worker raising wages relative to rents. While the expected sign emerges for the New World, it is negative everywhere else. Thus, and contrary to conventional economic intuition, rising land/labor ratios were typically associated with *falling*, not rising, wage/rental ratios in Europe and Asia. This counterintuitive result may, of course, reflect reverse causality. Rather than having exogenous changes in factor endowments driving wage/rental ratios, exogenous changes in commodity prices could be driving wage/rental ratios which induce factor supply responses, making land/labor ratios endogenous. The endogenous response of endowments would, presumably, be especially powerful during the mass migrations prior to World War I. In that case, why the New World would exhibit weaker reverse causality effects is not at all clear. Was land added to the production process so much faster in the New World? All of these factor endowment results need to be explored further.

Table 6 reports what happens when the regressions are modified to reflect regional eccentricities. Thus, things work better for: the New World and land-abundant Asia when we allow the impact of urbanization to be country-specific; Europe when we allow the impact of Pa/Pm to be country-specific; and land-scarce East Asia when we allow the impact of endowments to be country-specific. Given our priors, the results reported in Table 6 are an improvement over those of Table 5. The wrong sign on the land/labor ratio in East Asia (-0.89, Table 5) now is shown to be entirely due to Japan's uncooperative behavior (JAP, -1.32, Table 6) since the coefficient on the land/labor ratio in Taiwan (TAI, +2.89) and Korea (KOR, +6.51) is positive, significant and economically powerful. The magnification effect is also more visible in Table 6. The negative coefficient on Pa/Pm is now more significant and higher in East Asia (-0.37 vs -0.23); it is still significant and a bit higher in land-abundant Asia (-1.33 vs -1.28) and the New World (-0.67 vs -0.58); and, perhaps most strikingly, it is now discovered to have been far above unity in most of Europe -- Britain (-1.13), Denmark (-3.94) and Spain (-1.30) -- and close to unity in Ireland (-0.93) and Germany (-0.90).

[Table 6 about here]

Second Pass: Cointegration Analysis

The next step was to perform cointegration analysis for each group of countries (New World, Europe, land-abundant Asia, and land-scarce Asia), using the same panel data underlying Tables 5 and 6. If the hypothesis of cointegration is accepted, or, more accurately, if the null hypothesis of no cointegration is rejected, then the OLS equations in Tables 5 and 6 could, as we hope, be interpreted as a long-term relationship among the economic variables in question.

Prior to the cointegration analysis, however, it is necessary to check for the existence of unit root in the series or, alternatively, to check whether the series are integrated of first order I(1) or non-stationary with unit root.[15] Hence, the first step of this econometric analysis is to test for the non-stationary property

[15] A process for the series Y_t is said to be (weakly) stationary if neither the mean m_t nor the autocovariances g_t (the covariance of Y_t with its own lagged value) depend on the date t (Hamilton 1994: ch. 3, p. 45). A series is said to be integrated of order d, written I(d), if it must be differenced d times to become stationary. Thus, a stationary series is integrated of order zero, I(0); and a I(1) series is one that has to be differentiated once to become stationary.

of the series, which can be done through an Augmented Dickey Fuller (ADF) unit root test. The null hypothesis is that there exists a unit root (i.e., the series are non-stationary). The unit root test is traditionally applied to time series, but we are using panel data. This fact requires that we look for a different specification of the unit root test and apply different critical values. Using the model and critical values presented in Levin and Lin (1992), unit root tests are applied to the wage/rent ratio, Pa/Pm, the land/labor ratio and the urbanization series. The tests were performed separately for each group, allowing for country specific intercepts (where relevant).

It must be said at the start that the results are not always robust. This is true, in particular, for the land/labor variable in the New World, Europe and land-scarce Asia, and for the Pa/Pm variable in land-scarce Asia.[16] The weakness of these tests can be attributed to the method chosen for testing unit root and to the characteristics of the database (unbalanced panel data). One of the reasons for using panel data when testing for unit roots and cointegration is the fact that the use of panel data increases the number of observations available for the test, as compared to an independent test for each country. This is important because having a large number of observations is crucial when applying unit root and/or cointegration tests. (Note that in this paper countries have been assigned to the four regional groups based on the belief that they share common features.) Another advantage of using panel data when testing for unit root is the fact that the power of the unit root test increases.[17] Yet, there are significant disadvantages too. In particular, when applying the Levin and Lin (1992) model, and hence when using their critical values, it is implicitly assumed that the unit root coefficient is the same for all the countries within the regional group,

[16] The null hypothesis of I(1) cannot be rejected for the land/labor variable in Europe and land-scarce Asia when specific intercepts are included in the unit root test, but it is rejected when they are not included. The opposite effect occurs for the land/labor variable in the New World. As for the Pa/Pm variable in land-scarce Asia, the null of I(1) is rejected when using DF test but not when using ADF test (though the lags are not significant in the ADF test).

[17] The power of a test consists of one minus the probability of doing a type II error, and a type II error consists of accepting (or not rejecting) a null hypothesis when it is false.

which may not be true. An alternative test is offered Im, Pesaran and Shim (1996, henceforth IPS: see Maddala and Kim 1998). IPS relax the Levin and Lin assumption by running individual unit root tests for each of the cross-section units (e.g., our 19 countries) and showing that the distribution of the unit root t-statistics converges to a standard normal distribution. An advantage of the IPS test is that it can combine the evidence on the unit root hypothesis arising from the individual unit root tests. A disadvantage, however, is that it assumes a balanced panel data set – each country must have observations over the same time series – which is not the case of the data set in this paper. Another alternative test for unit root in panel data, as explained in Maddala and Kim (1998), also combines the evidence from several independent unit root tests. This alternative test uses a statistic constructed using the significance levels (p-values) of the individual unit root tests, and this statistic has an exact χ^2 distribution.[18] The disadvantage of this test, however, is that the p-values have to be derived by Monte Carlo methods, an enterprise which would take us far beyond the scope of this paper.

These arguments suggest that we stick with the Levin and Lin method, although recognizing that the results may be weak due to the method used and limits imposed by our data. Since the variables are I(1),[19] the second step is to run the cointegration regressions by group and then to check for non-stationarity in the residuals. Thus, the test for cointegration consists of a unit root test on the residuals, where the null hypothesis is that there is no cointegration. Once again, since we are using panel data, and not simply time series, it is not correct to use the conventional critical values when testing for cointegration.[20] According to Kao (1999), when testing for cointegration in panel data, the distribution of

[18] After running individual unit root tests, a statistic is constructed using the significance levels (p-values, pi) of the individual tests. This statistic, ($-2 \Sigma \log(pi)$), has a χ^2 distribution with 2N degrees of freedom.

[19] Which, again, is a weak result in the case of the land/labor variable in Europe, land-scarce Asia and the New World, and for Pa/Pm variable in land-abundant Asia.

[20] When using pure time series, the conventional critical values used to check for the existence of unit root on the series that enter the cointegration equation are not the same as the ones used to check for

the statistic typically converges to a standard normal distribution. Hence, the cointegration tests presented in Table 5 use Kao's criteria.

In all four groups -- New World, Europe, land-abundant Asia and land-scarce Asia -- the null of no cointegration is rejected (Table 5, bottom two lines). This happy result must be interpreted with caution for at least two reasons. First, as already noted, the weakness of the unit root test performed on our data does not allow too much (statistical) confidence in the cointegration results.[21] Second, to the extent that the cointegration relations in Table 5 are associated with long-term relationships among the variables, this would imply that the effect of the land/labor variable on the wage/rent ratio is negative for Europe and Asia. This is clearly a counterintuitive result that is likely to be associated with endogeneity issues. As a result, the next section deals with causality analysis between the endowment (land/labor) and factor price (wage/rent) variables.

Third Pass: Causality Analysis

Table 7 reports the Granger causality tests for the endowment and factor price variables. Only three regions are included there: in contrast with the rest, the unit root test for the New World group was not weak, and also recall that the signs on the coefficient for land/labor ratio in the New World regressions (Tables 5 and 6) are "correct." Table 7 confirms that there was plenty of two-way causality between

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non-stationarity in the residuals. The reason is that the statistics' distributions are different. A similar result occurs when using panel data, but the critical values are also different than the conventional ones.

[21] A cointegration analysis was also performed for the equations of Table 5 excluding the land/labor variable for the New World, Europe and land-scarce Asia. An interesting result was that the coefficient for urbanization became positive and significant for the New World, while the coefficient for Pa/Pm stayed negative and significant (though its value decreased). In the case of Europe, the coefficient for Pa/Pm increased to –0.78 while the one for urbanization increased to 0.76, and both remained significant at 1percent. The coefficient for urbanization also increased for land-scarce Asia (to 0.78 and stayed significant at 1percent), but the coefficient on Pa/Pm became insignificant. The surprising result is that the null hypothesis of no cointegration was also rejected on these equations, although we know that the cointegration test may fail when relevant variables are omitted from the cointegration equation.

land/labor ratios and wage/rental ratios around the world between 1870 and 1940. Wage/rental ratios had an influence on land/labor ratios in parts of Europe (Britain, Ireland and Spain), in parts of land-abundant Asia (Egypt), and in parts of land-scarce Asia (Japan and Taiwan). We need to learn much more about how this process worked. Was it through across-border migration? Was it through local decisions on marriage age and fertility within marriage? Was it through nutrition and child survival? Or, was it through land settlement? And how did these endowment responses to relative factor scarcity differ across world regions? Furthermore, by using wage/rental and land/labor ratios throughout we have imposed the restriction that labor responded to the real wage the same way that land responded to rents, an assumption that must surely have been violated. Thus, Table 7 can only set the agenda since this paper is already too long to embark at this point on a search for persuasive answers to these questions.[22]

[Table 7 about here]

A Concluding Remark

There were powerful forces at work in the global economy before 1940, and they certainly included what we now call the Third World. Two important facts have now been established. First, there was commodity price convergence within and between the Atlantic Economy, Latin America, the Middle East and Asia, and the price convergence was bigger in the rest of the world than it was in the Atlantic Economy. Second, relative factor prices were converging world-wide at the same time that living standards and income per capita (e.g., absolute factor prices) were diverging between center and periphery. Theory suggests that the simultaneous occurrence of income per capita divergence and relative factor price

[22] The author is pursuing these issues in separate research on mass migrations within the Third World, on the elastic labor supply thesis introduced by W. Arthur Lewis a half century ago (Lewis 1954, 1970, 1978a, 1978b), and on the land settlement process treated formally recently by Ronald Findlay (1995).

convergence could only take place in a global environment where very uneven rates of technological progress and capital deepening coexisted with very powerful and ubiquitous globalization forces. Theory is correct.

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Table 1
Global Transport Cost Changes
and Commodity Price Convergence Indicators 1870-1990

1. The Big Bang Era Before World War I

The Greater Atlantic Economy

A. Transport Declines		
American export routes, deflated freight cost	1869/71-1908/10	100 to 55
American east coast routes, deflated freight cost	1869-71-1911/13	100 to 55
Addendum: freight cost/wheat price		41 to 22.6% or **4.6% pts per decade**
British tramp, deflated freight cost	1869/71-1911/13	100 to 78
B. Commodity Price Convergence		
Liverpool vs Chicago, wheat price gap	1870-1912	58 to 16%
London vs Cincinnati, bacon price gap	1870-1913	93 to 18%
Philadelphia vs London, pig iron price gap	1870-1913	85 to 19%
London vs Boston, wool price gap	1870-1913	59 to 28%
London vs Buenos Aires, hides price gap	1870-1913	28 to 9%

The Third World

A. Transport Declines		
Rangoon to Europe, freight costs/rice price	1882-1914	74 to 18%
Addendum: freight cost/rice price		74 to 18% or **18.7% pts per decade**
Java to Amsterdam, freight costs on sugar	1870-1914	100 to 40 or 50
Nagasaki to Shanghai, freight costs on coal	1880-1910	100 to 24
B. Commodity Price Convergence		
Liverpool vs Odessa, wheat price gap	1870-1906	40 to 2%
Liverpool vs Bombay, cotton price gap	1873-1913	57 to 20%
London vs Calcutta, jute price gap	1873-1913	35 to 4%
London vs Rangoon, rice price gap	1873-1913	93 to 26%
Liverpool vs Alexandria, cotton price gap	1837/46-1890/99	63 to 5%

2. The Slow Down to Steady State Era 1920-1990

A. Transport Costs		
World Bank deflated ocean freight cost index	1920-1940	100 to 68
Addendum: freight costs/wheat price		27.5 to 18.7% or **4.4% pts per decade**
World Bank deflated ocean freight cost index	1950-1990	100 to 76
Addendum: freight costs/wheat price		18.7 to 14.2% or **1.1% pts per decade**

Notes: Panel 2 comes from Baldwin and Martin (1999, Figure 4), while Panel 1 is from O'Rourke and Williamson (1994, 1999a). In the addenda, the freight cost/wheat price bases, to which the changing freight cost index is applied, are based on Baldwin and Martin (1999, Table 6).

Table 2

Summary of Global Pa/Pm and Pexp/Pimp Changes on Either Side of World War I (in percent)

Region	(1) Early 1890s to WWI	(2) Early 1870s to WWI	(3) Interwar	(4) Regime Switch (3)-(1)
A. Pa/Pm Changes				
Land Abundant New World				
with Argentina and Uruguay	30.2	22.2	-15.5	-45.7
without Argentina and Uruguay	17.7	-0.2	-14.5	-32.2
Land Abundant Third World				
with Argentina and Uruguay	31.6	40.5	-9.1	-40.7
without Argentina and Uruguay	22.9	27.2	-4.0	-26.9
Average Land Abundant Countries	27.0	24.2	-11.2	-38.2
Land Scarce Third World	22.7	14.4	-3.3	-26.0
Land Scarce Europe	9.0	20.5	-5.6	-14.6
Average Land Scarce Countries	12.0	19.7	-4.9	-16.9
Land Abundant New World				
with Argentina and Uruguay	16.3	45.1	3.5	-12.8
Without Argentina and Uruguay	10.7	25.7	7.8	-2.9
Land Abundant Third World				
with Argentina and Uruguay	21.1	48.5	-4.0	-25.1
Without Argentina and Uruguay	19.3	21.2	-4.8	-24.1
Average Land Abundant Countries	17.6	37.1	0.4	-17.2
Land Scarce Third World	-18.4	9.5	-23.1	-4.7
Land Scarce Europe	0.9	1.9	11.1	10.2
Average Land Scarce Countries	-3.9	3.4	0.8	4.7

Source: Calculated from Appendix Tables 1 and 2, unweighted. Land Abundant New World =Australia, Canada, and USA; Land Abundant Third World = Burma, Egypt, The Punjab, and Thailand; Land Scarce Third World = Japan, Korea, and Taiwan; Land Scarce Europe = Great Britain, Denmark, Ireland, Sweden, France, Germany and Spain. Panel A: Early 1890s=1890-94 (except Taiwan, which is 1900-04), WWI=1910-14, Early 1870s=1870-74 (with smaller sample), and Interwar=1910-14 to 1935-39 (excluding Burma and Denmark). Panel B: Early 1890s=1890-94 (except Taiwan, which is 1895-99), WWI=1910-14, Early 1870s=1870-74 (with smaller sample), and Interwar=1910-14 to 1935-39 (except Ireland, which is 1920-24, and excluding Burma).

Table 3

Wage/Rental Ratio Trends in Europe and the New World, 1870-1939 (1911=100)

Period	Land Abundant			Land Scarce							
	Australia	Canada	USA	Britain	Denmark	France	Germany	Ireland	Spain	Sweden
1870-1874	416.2		233.6	56.6	44.8	63.5	84.4		51.3	42.7
1875-1879	253.0		195.0	61.4	43.5	62.9	80.0	62.2	55.8	43.7
1880-1884	239.1		188.3	64.9	44.8	67.3	82.3	72.7	58.6	50.7
1885-1889	216.3		182.1	73.1	56.6	73.8	86.0	86.4	73.0	57.8
1890-1894	136.2		173.5	79.1	66.7	80.4	98.0	102.7	81.8	65.3
1895-1899	147.7		175.0	87.3	87.9	91.8	108.2	122.1	85.5	78.6
1900-1904	130.0	81.4	172.4	91.4	103.8	103.2	107.6	111.2	74.9	87.9
1905-1909	97.9	93.4	132.7	98.1	99.7	106.4	104.6	101.7	85.7	92.5
1910-1914	100.6	95.6	101.1	102.7	100.0	99.8	100.2	94.1	86.4	99.1
1915-1919	111.0	134.3	124.7	153.1		123.7		79.7	52.5	143.4
1920-1924	137.2	146.5	122.4	197.6		156.5		105.7	38.8	136.5
1925-1929	115.1	236.4	160.1	167.6		117.1		168.6	38.7	116.3
1930-1934	98.3	219.2	165.2	190.3		133.1		192.3	39.1	135.1
1935-1939	110.5	225.1	240.1	206.5		168.2		227.8		

Sources and Notes: The Canadian figure for 1900-1904 is actually 1901-1904, the British figure for 1935-1939 is actually 1935-1936, the Danish figure for 1910-1914 is actually 1910-1912, the German figure for 1910-1914 are actually 1910-1913, the Irish figure for 1875-1879 is actually 1876-1879, the Spanish figure for 1930-1934 is actually 1930-1933, and the Swedish figure for 1930-1934 is actually 1930. See appendix for sources.

Table 4

Wage/Rental Ratio Trends in the Third World, 1870-1939 (1911=100)

Period	Land Abundant						Land Scarce		
	Argentina	Uruguay	Burma	Siam	Egypt	The Punjab	Japan	Korea	Taiwan
1870-1874		1112.5		4699.1		196.7			
1875-1879		891.3		3908.7	174.3	198.5			
1880-1884	580.4	728.3		3108.1	276.6	147.2			
1885-1889	337.1	400.2		2331.6	541.9	150.8	79.9		
1890-1894	364.7	377.2	190.9	1350.8	407.5	108.7	68.6		
1895-1899	311.1	303.6	189.9	301.3	160.1	92.0	91.3		
1900-1904	289.8	233.0	186.8	173.0	166.7	99.8	96.1		68.1
1905-1909	135.2	167.8	139.4	57.2	64.4	92.4	110.4	102.8	85.2
1910-1914	84.0	117.9	106.9	109.8	79.8	80.1	107.5	121.9	96.6
1915-1919	53.6	120.8	164.7	202.1	83.5	82.5	104.9	109.4	111.2
1920-1924	53.1	150.3	113.6	157.9	124.3	81.1	166.1	217.4	140.0
1925-1929	51.0	150.2		114.9	120.8	72.6	202.4	209.2	134.8
1930-1934	58.4	174.3		113.1	116.2	50.4	229.5	194.0	130.7
1935-1939	59.5	213.5		121.6	91.0	33.2	149.9	215.4	123.6

Sources and Notes: The Argentine figure for 1880-1884 is actually 1883-1884, the Burmese figure for 1920-1924 is actually 1920-1923, the Egyptian figure for 1875-1879 is actually 1877-1879, the Punjab figure for 1870-1874 is actually 1873-1874, the Japanese and Korean figures for 1935-1939 are actually 1935-1938, the Korean figure for 1905-1909 is actually 1909 and the Taiwanese figure for 1900-1904 is actually 1904. See the appendix for sources.

Table 5

OLS Estimation with Fixed Effects, 1870-1940
Dependent Variable: Wage/Rental Ratio

Variables	All Countries	New World	Europe	Asia: Land Abundant	Asia: Land Scarce
Pa/Pm	-0.62*	-0.58*	-0.44*	-1.28*	-0.23***
	(0.093)	(0.121)	(0.098)	(0.251)	(0.138)
Land/Labor	-0.22**	0.32*	-0.87*	-3.94*	-0.89***
	(0.088)	(0.086)	(0.088)	(0.639)	(0.473)
Urbanization	0.22*	-0.95*	0.50*	-0.43	0.60*
	(0.072)	(0.102)	(0.052)	(0.501)	(0.116)
Constant	8.67*	4.42*	11.14*	27.36*	10.82*
	(0.556)	(0.670)	(0.486)	(2.617)	(2.111)
Observations	1055	308	404	226	117
Adj. R sq.	0.40	0.44	0.64	0.44	0.57
Cointegration test	--	-2.22	-3.41	-2.57	-5.62
Signif. level	--	5%	1%	1%	1%

Notes: (*): significant at 1%, (**): significant at 5%. The first row indicates the coefficient estimates and the second row the standard deviation (in parenthesis). All variables are in natural logarithms, and the estimations are OLS with fixed effects. New World: Argentina, Australia, Canada, Uruguay, and USA; Europe: Great Britain, Denmark, France, Germany, Ireland, Spain, and Sweden; Land Abundant Asia: Burma, Egypt, the Punjab, and Thailand; Land Scarce Asia: Japan, Korea, and Taiwan. In assessing significance of the cointegration tests, the critical values are taken from the Normal Distribution (one tail test).

Table 6

Specific Group Estimations, OLS with Fixed Effects, 1870-1940
Dependent Variable: Wage/Rental Ratio

New World		Europe		Asia: Land Abundant		Asia: Land Scarce	
Variables	Coefficients	Variables	Coefficients	Variables	Coefficients	Variables	Coefficients
Pa/Pm	-0.67*	Pa/Pm x GB	-1.13*	Pa/Pm	-1.33*	Pa/Pm	-0.37*
	(0.073)		(0.356)		(0.214)		(0.136)
Land/Labor	0.85*	Pa/Pm x DEN	-3.94*	Land/Labor	-4.80*	Land/Labor x TAI	2.87**
	(0.081)		(0.803)		(0.567)		(1.179)
Urb x ARG	-4.94*	Pa/Pm x SWE	0.99*	Urb x EGY	-6.20*	Land/Labor x KOR	6.51***
	(0.210)		(0.256)		(0.952)		(3.551)
Urb x AUS	-0.81*	Pa/Pm x IRE	-0.93*	Urb x THA	0.64	Land/Labor x JAP	-1.32***
	(0.114)		(0.274)		(0.446)		(0.707)
Urb x CAN	0.43***	Pa/Pm x FRA	-0.34**	Urb x IND	-7.84*	Urb x TAI	0.19
	(0.224)		(0.136)		(1.340)		(0.167)
Urb x URU	-0.78*	Pa/Pm x GER	-0.90*	Urb x BUR	-4.10	Urb x KOR	2.86**
	(0.254)		(0.247)		(2.994)		(1.111)
Urb x USA	0.07	Pa/Pm x SPA	-1.30*	Constant	15.29*	Urb x JAP	0.65*
	(0.101)		(0.407)		(2.832)		(0.178)
Constant	-3.55*	Land/Labor	-0.79*			Constant	-6.26
	(0.713)		(0.097)				(5.500)
		Urbanization	0.41*				
			(0.060)				
		Constant	13.80*				
			(1.376)				
Observations	308		404		226		117
Adj. R sq.	0.81		0.69		0.60		0.63

Notes: (*): significant at 1%, (**): significant at 5%, (***) significant at 10%. The first row indicates the coefficient estimates and the second row the standard deviation (in parenthesis). All variables are in natural logarithms, and the estimations are OLS with fixed effects. New World: Argentina, Australia, Canada, Uruguay, and USA; Europe: Great Britain, Denmark, France, Germany, Ireland, Spain, and Sweden; Land Abundant Asia: Burma, Egypt, the Punjab, and Thailand; Land Scarce Asia: Japan, Korea, and Taiwan.

Table 7

Granger Causality Tests between Wage/Rent (WR) and Land/Labor (LL) Ratios

Country	From (lags)	To (lags)	Causality	Signif. level	Observ.
A. Europe					
Great Britain	LL (1)	WR (1)	Yes	1%	65
	WR (3)	LL (1)	Yes	1%	60
Denmark	LL (6)	WR (8)	No	--	34
	WR (9)	LL (1)	No	--	34
Sweden	LL (2)	WR (2)	No	--	58
	WR (1)	LL (1)	No	--	60
Ireland	LL (8)	WR (8)	No	--	56
	WR (7)	LL (1)	Yes	8%	57
France	LL (9)	WR (10)	Yes	1%	60
	WR (4)	LL (1)	No	--	66
Germany	LL (1)	WR (9)	Yes	5%	34
	WR (8)	LL (5)	No	--	36
Spain	LL (4)	WR (6)	No	--	49
	WR (1)	LL (1)	Yes	3%	53
B. Asia land-abundant					
Egypt	LL (10)	WR (3)	No	--	43
	WR (3)	LL (6)	Yes	3%	48
Thailand	LL (1)	WR (1)	No	--	68
	WR (1)	LL (1)	No	--	69
India	LL (2)	WR (1)	No	--	66
	WR (6)	LL (2)	No	--	60
Burma	LL (1)	WR (2)	No	--	31
	WR (1)	LL (4)	No	--	33
C. Asia land-scarce					
Taiwan	LL (5)	WR (1)	No	--	33
	WR (3)	LL (1)	Yes	4%	33
Korea	LL (3)	WR (7)	Yes	4%	21
	WR (1)	LL (1)	No	--	28
Japan	LL (2)	WR (3)	No	--	50
	WR (1)	LL (1)	Yes	2%	53

Notes: The determination of the optimal number of lags (in parenthesis) for WR and LL was made using Akaike and Shwartz Bayesian information criteria. Some of the results, however, must be interpreted with caution due to the limited number of observations available.

Figure 1
Pa/Pm Ratio, 1870-1940, (1911=100)
Egypt, Great Britain, Thailand and Uruguay

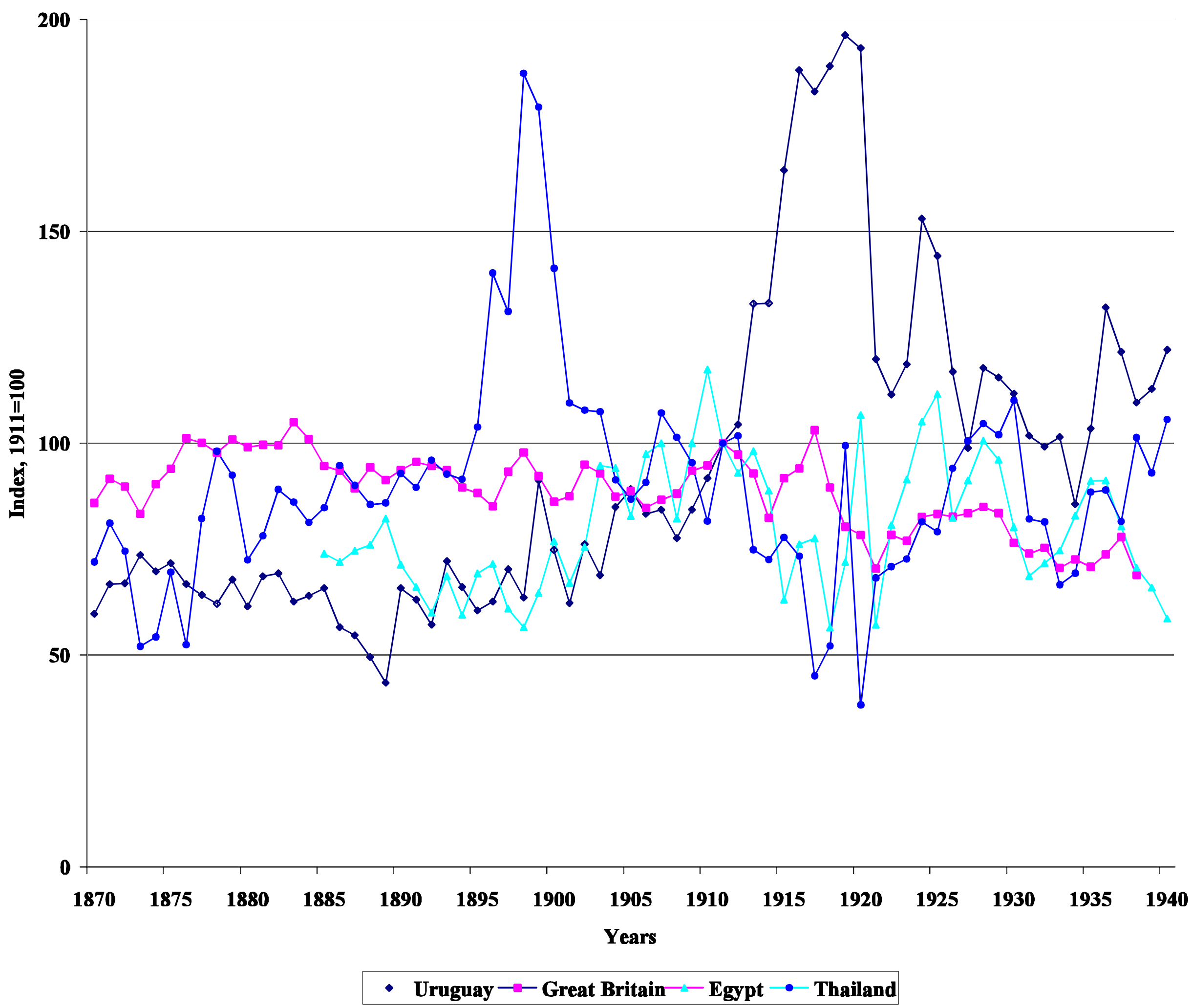


Figure 2

The Geometric Dual of the Three-Factor, Three-Good General Equilibrium Model

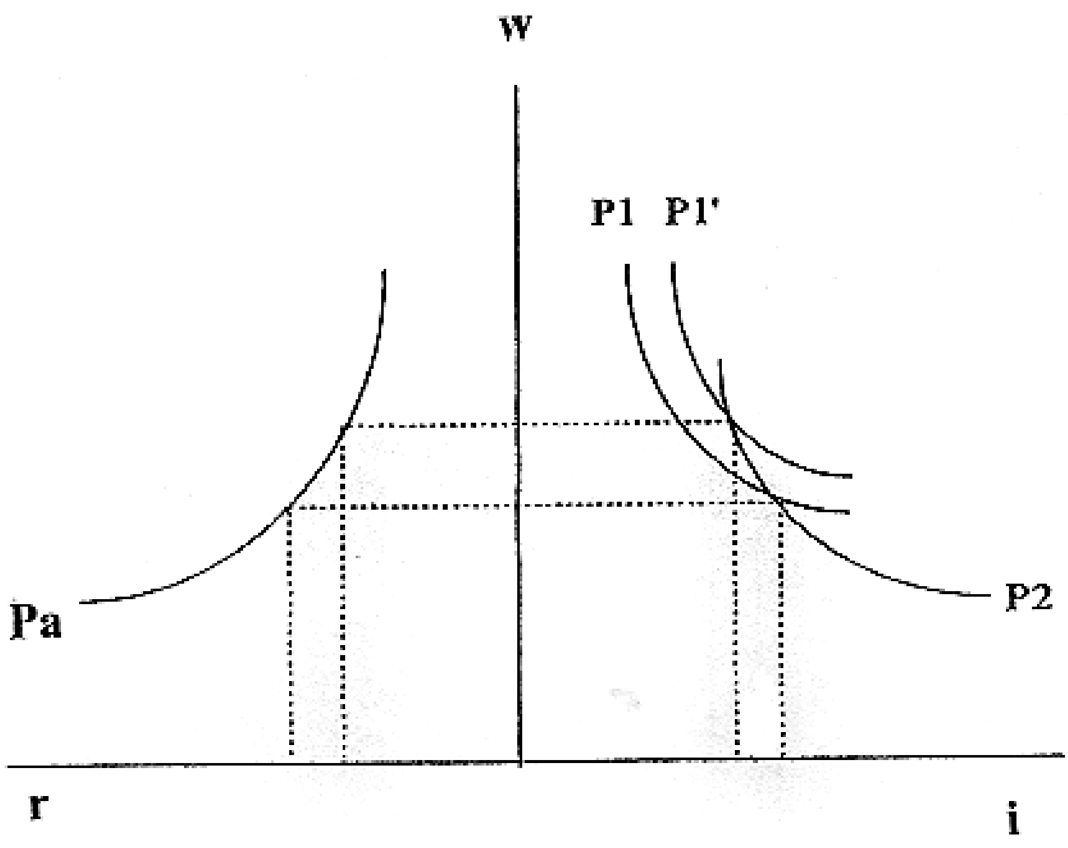


Figure 3
Wage/Rent Ratio, 1870-1940, (1913=1.0)
Egypt, Great Britain, Thailand and Uruguay

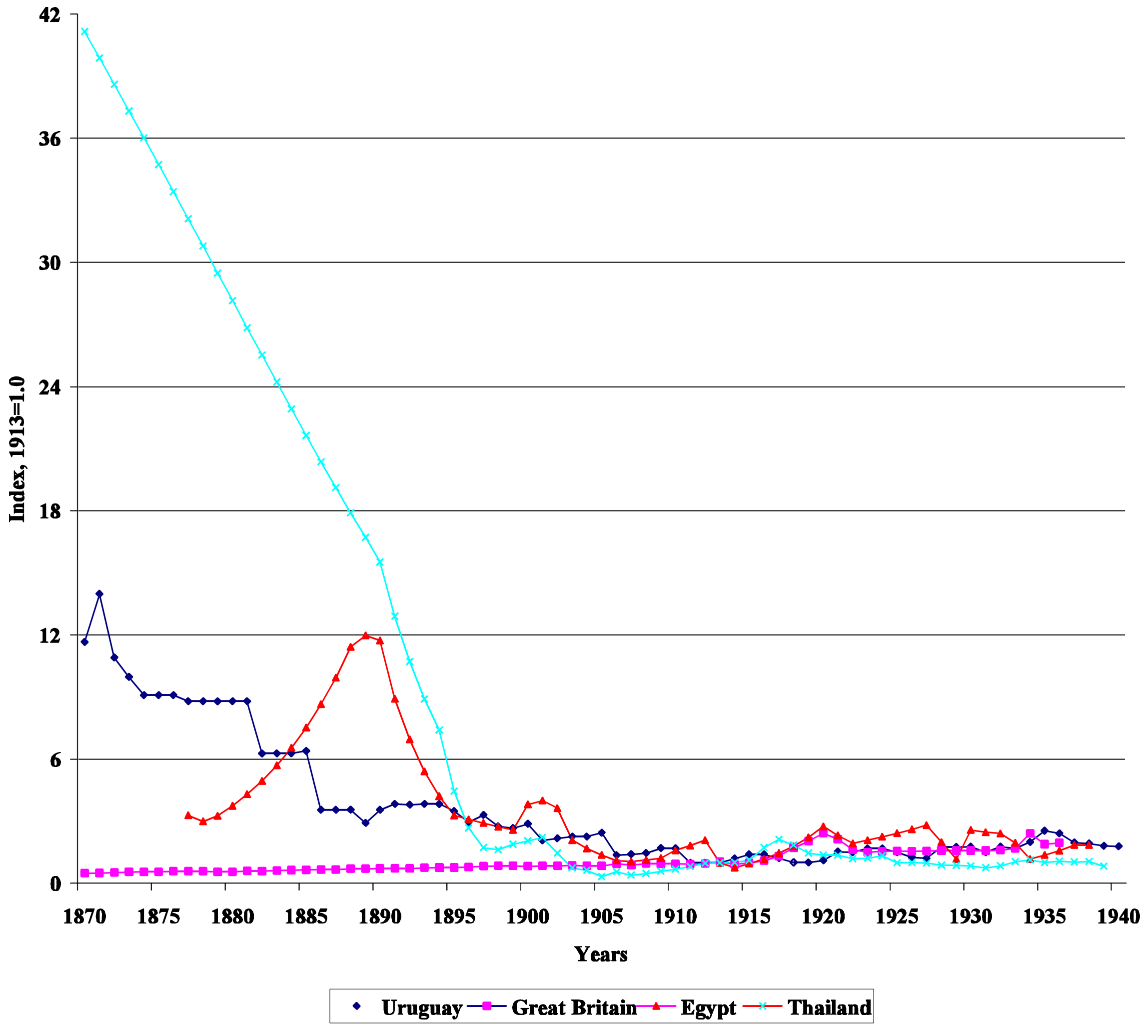
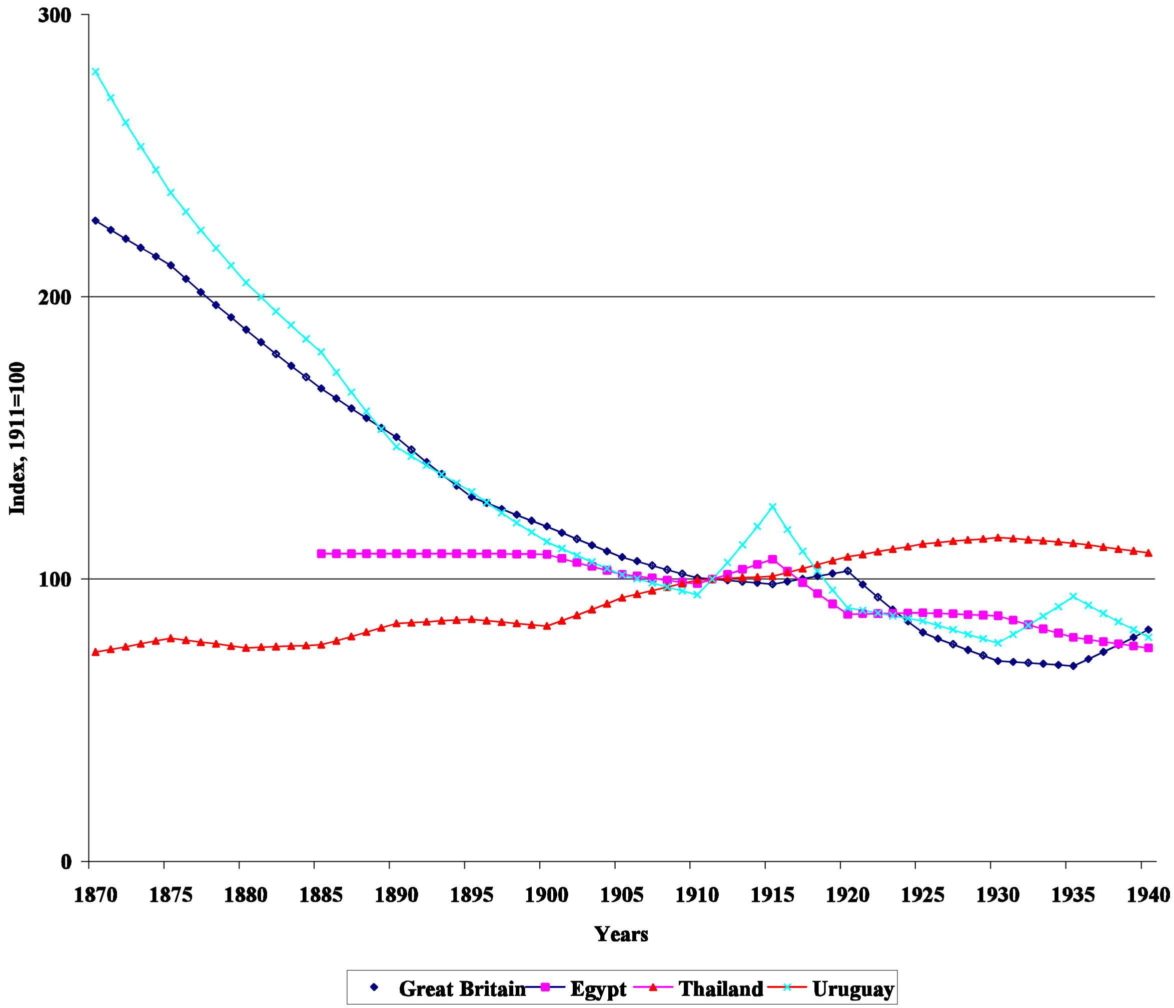


Figure 4
Land/Labor Ratio, 1870-1940, (1911=100)
Great Britain, Egypt, Thailand and Uruguay



Appendix: Data Sources

1. Wage-Rental Ratios

Except for the cases which follow, the wages and wage-rental ratios are taken from my previous publications as follows: "Real Wages, Inequality, and Globalization in Latin America Before 1940," *Revista de Historia Economica* 17, special number (1999), pp. 101-42; "Globalization, Factor Prices and Living Standards in Asia Before 1940," in *Asia Pacific Dynamism 1500-2000*, ed. by A. J. Latham (London: Routledge, forthcoming); "Real Wages and Factor Prices Around the Mediterranean 1500-1940," in *Globalization Challenge and Economic Response in the Mediterranean Before 1950*, ed. by S. Pamuk and J. G. Williamson (London: Routledge, forthcoming); and "Factor Price Convergence in the Late Nineteenth Century," *International Economic Review* 37, 3 (August 1996), pp. 499-530, with K. O'Rourke and A. M. Taylor (hereafter *OTW*). All of these data, and the three Harvard Institute for Economic Research discussion papers with their detailed appendices (HIER Discussion Papers 1842 July 1998, 1844 August 1998, 1853 October 1998), can be found at my website

http://www.economics.harvard.edu/~jwilliam/

where the reader is welcome to browse and download.

The countries and periods added to or replacing the wage/rental series listed above use the sources above for nominal wage rates in the denominator, but the nominal land rent (or land value) data in the numerator are from :

Australia 1914-1940

The unit value of unimproved land from R. H. Scott, "The Value of Land in Australia," paper presented to the *Australian and New Zealand Association for the Advancement of Science*, Adelaide (1969).

Britain 1870-1936

1870-1914: Land rents from M. E. Turner, J. V. Beckett and B. Afton, *Agricultural Rent in England 1690-1914* (Cambridge: Cambridge University Press, 1997), Appendix Table A2.2, pp. 314-8.
1914-1936: Land rents from H. A. Rhee, *The Rent of Agricultural Land in England and Wales* (London: Central Landowners Association, 1949), Appendix Table 2, pp. 44-5.

Canada 1901-1941

Geometric interpolation between census observations on land rents per acre: 1901-21, *Sixth Census of Canada, 1921, Vol. V* (Ottawa: King's Printer, 1925), p. xxxvi; 1931, *Seventh Census of Canada, 1931, Vol. VIII* (Ottawa: King's Printer, 1936), p. 20; 1941, *Eighth Census of Canada, 1941, Vol. VII, Part I* (Ottawa: King's Printer, 1947), Table 1, p. 4 and Table 28, p. 20.

France 1870-1940

Taken from Maurice Levy-Leboyer, *Le Revenue Agricole et la Rente Fonciere en Basse-Normandie: Etude de Croissance regionale* (Paris: Editions Lincksieck, 1972), Table K-62, p. 200 where he reports a land rent series for the whole region (variant II, col. 4).

Ireland 1913-1940

Land rents per acre in the Limerick are from Donald Nunan, "Price Trends for Agricultural Land in Ireland 1901-1986," *Journal of Agricultural Economics and Rural Sociology* 12 (1987), Appendix A, Table 1, pp.

69-70. Land rents = average rents (in pounds) per statute acre. Hereafter *Nunan*.

Spain 1870-1934
Land rents, based on Spanish farmlands sold in each year and a new series for mortgage interest rates, from personal correspondence with Juan Carmona and Joan Roses.

Sweden 1914-1930
Value of new land brought under cultivation (per hectare), from E. Lindahl, E. Dahlgren and K. Kock, *Wages, Cost of Living and National Income in Sweden 1860-1930: Volume III: National Income of Sweden 1861-1930, Part 2* (London: P. S. King and Son, 1937), Table 126, p. 393.

Uruguay 1870-1940
From personal correspondence with Luis Bertola.

United States 1914-1940
Purchase value of farmland per acre from Peter H. Lindert, "Long-run Trends in American Farmland Values," *Working Paper No. 45*, Agricultural History Center, University of California, Davis (February 1988), Table 1, following p. 5.

Burma 1890-1923
This series reports average rent per acre in lower Burma, based on Annual Reports of the Land Revenue Administration in Cheng Siok-Hwa, *The Rice Industry of Burma 1852-1940* (Kuala Lumpur: University of Malaya Press, 1968), Table VI.7, p. 162. The years 1891-1894 and 1896-1899 were filled in by geometric interpolation.

Punjab 1873-1940
K. Mukerji, "Land Prices in Punjab," in *Trends of Socio-Economic Change in India 1871-1961*, ed. M. K. Chaudhuri (Simla: Indian Institute of Advanced Study, 1969) reports two land price series in Table 6: one for the average price of all land (for every Census year from 1871 to 1961) and the other for the average price of "cultivated" land (for 1897 and every Census year from 1901 to 1961). Mukerji also gives the average price of all land in 1866 and 1862-63 (p. 533). Finally, he gives the average prices -- both for cultivated land and for all land -- during the periods 1899-1900, 1913-1914, 1938-1939, 1944-1945, 1947-1948 and 1962-1963 in his Table 1. Even after combining these three groups of data, there were still many gaps in the land price series, which were filled using geometric interpolation. Mukerji also reports two-year moving averages for periods starting with 1915-1916 and ending with 1948-1949 (Appendix I), but we elected not to use it because the data were inconsistent with that of the rest in his paper. Finally, due to Delhi's proximity to Punjab (and the absence of wage data for the Punjab), nominal wages in Delhi were used to calculate the wage to land price ratio.

Thailand 1870-1939
<u>1915-1941</u>: David Feeny, *The Political Economy of Productivity: Thai Agricultural Development 1880-1975* (Vancouver: University of British Columbia Press, 1982), Table A1.8, p. 137, presents land price data that corresponds to the average value per hectare of new mortgages registered in that year. The mortgages are for paddy land, which was for the most part found in the Central Plain, the major rice export producing region.
<u>1890-1915</u>: Feeny (Table A1.7, p. 135) also presents data on land values going back to 1889 for different locations and qualities of paddy land. Even when most of the observations are for the Central Plain, comparisons are difficult because of differences in fertility, access to transportation, severity of floods, and

other factors. With this in mind, we constructed a series for 1889-1926 using the information we considered most reliable and similar to the one for the 1915-1941 series. Then, we linked this new series with the 1915-1941 one, using as a link the average of 1915-1926 for the former and the year 1920 for the latter. Where data were missing, we interpolated by taking a geometric approximation between the two closest data points.
1870-1890: Feeny (Table 6-2, p. 89) also presents average real land rents for the decade 1864-1874. We took this rent benchmark as corresponding to 1870, and we transformed it to a nominal land rent, using information on paddy prices given in his Table A1.1 (pp. 127-9). We also had information for the nominal land rent in 1903 (from his Table 6-2). We assumed that the trend of the nominal land rent for 1870-1903 offered a good proxy for the trend in the nominal land price in this period. This allowed us to obtain an index of nominal land price for 1870 and to complete the series for 1870-1890 by doing geometric interpolation. We estimated an alternative nominal land price series for 1870-1890 using information provided by Feeny in his Table A1.7 where he presents a nominal rent value for 1890. We calculated the annual average geometric growth rate of the nominal rent value for 1870-1890 and used this growth rate to backcast our land price index to 1870. This procedure assumes, of course, that the nominal land rent behavior in 1870-1890 is a good proxy for the nominal land price. These two alternative land price series appear to establish an upper and lower bound for trends 1870-1890. Hence, our final land price series for 1870-1890 is a simple average of the two.

2. Commodity Prices

We sought the following relative prices for all countries in the 19-country wage-rental sample, all quoted in the home market:

> **TOT (=Pexp/Pimp** in the text): price index for external terms of trade, export price index/import price index
> **Pa/Pm:** ratio of the price index of agricultural goods to manufactured goods in home market

Any deviations from the above definitions of TOT and Pa/Pm are noted below. All the sources use annual data published by each government in question. That is, no price index was indirectly calculated from another country's statistics.

Argentina 1885-1940

TOT: 1885-1913, A. G. Ford, "Export Price Indices for the Argentine Republic 1881-1914," *Inter-American Economic Affairs* 9, 2 (Autumn 1955), Tables I and III, pp. 45-6 and 49; 1913-1939, Instituto de Estudios Economicos sobre la Realidad Argentina y Latinoamericana (herafter *IEERAL*), "Estadisticas de la evolucion economica de Argentina, 1913-1984," Estudios 9, 39 (July/September 1986), pp. 103-84.
Pa: 1885-1913, *OTW*; 1913-1940, *IEERAL*.
Pm: 1885-1913, *OTW*; 1913-1940, *IEERAL*.

Australia 1870-1940

TOT: 1872-1900, W. Vamplew, ed., *Australians: Historical Statistics* (Broadway, NSW: Fairfax, Syme & Weldon, 1987), ITFC 81-83, col. 83, p. 194 (hereafter *Vamplew*); 1901-1940, *Vamplew*, PC 80-89, cols. 87 and 88, p. 220.
Pa: Price index for the agricultural component of GDP. *Vamplew*, p. 217, pp. 61-70, col. 62.
Pm: Price index for the manufacturing component of GDP. *Vamplew*, p. 217, pp. 61-70, col. 66.

Britain 1870-1938

TOT: 1870-1933, Werner Schlote, *British Overseas Trade* (Oxford: Basil Blackwell, 1952), Table 26, cols. 9 and 10, pp. 175-8; 1933-1938, B. R. Mitchell and P. Deane, *Abstract of British Historical Statistics* (Cambridge: Cambridge University Press, 1962), pp. 331-2 (hereafter *ABHS*).

Pa: 1870-1913, total agricultural product price index, *ABHS*, pp. 471-3; 1913-1938, total food price index, *ABHS*, p. 475.

Pm: Price index of merchandise exports (proxy for manufactured prices for the UK), Imlah and Board of Trade. *ABHS*, p. 331-2.

Canada 1901-1941

TOT: M. C. Urquhart and K. A. H. Buckley, eds., *Historical Statistics of Canada* (Cambridge: Cambridge University Press, 1965), hereafter *HSC*. Export price index: Series J, cols. 84 and 108 were linked, pp. 299 and 301. Import price index: Series J, cols. 96 and 118 were linked, pp. 300 and 302.

Pa: Wholesale price index of Canadian farm products, *HSC*, Series J, col. 77, p. 298.

Pm: Wholesale price index of "fully and chiefly" manufactured goods, *HSC*, Series J, col. 71, p. 297.

Denmark 1870-1940

TOT: 1870-1875, H. C. Johansen, *Danmarks Historie Bind 9: Dansk ƒkonomisk Statistik 1814-1980* (Copenhagen: Gyldendalske Boghandel, 1985), Table 4.7, col. 5, p. 217 (hereafter *Johansen*); 1875-1940, N. Kaergard, *Nkonomisk Vaekst: En Nkonometrisk Analyse af Danmark 1870-1981* (Copenhagen: Jurist-og ϕkonomforbundets Forlag, 1991), cols. 2 and 3, p. 578 (hereafter *Kaergard*).

Pa: Total agricultural production price index. 1870-1900 from S. A. Hansen, *Nkonomisk Vaekst I Danmark, Bind 2: 1914-1983* (Copenhagen: University of Copenhagen, 1983), Table 18, col.11, pp. 295-6; 1900-1940, from *Kaergard*, Table 1, col. 4, pp. 578-9.

Pm: Wholesale price index, constructed from 38 commodities. *Johansen*, Table 8.1, pp. 298-301; 1876-1914 uses col. 4; 1870-1875 uses col. 1 (consumer price index) linked with col. 4.

France 1870-1940

TOT: 1870-1896, C. P. Kindleberger, *The Terms of Trade: A European Case Study* (Cambridge: MIT Press, 1956), Table 2-1, pp. 12-13 (hereafter *Kindleberger*); 1896-1939, P. Villa, *Une Analyse Macroeconomique de la France au XXeme siecle*, (Paris: CNRS Editions, Monographies d'Econometrie, 1993), pp. 445-6, PEX=export prices, PIM=import prices (hereafter *Villa*).

Pa: Production prices of the agriculture sector, *Villa*, p. 445 (PPU01 variable).

Pm: Production prices of manufactured consumption goods (textiles, clothing, leather and skins, furniture, etc), *Villa*, p. 446 (PPU06 variable).

Germany 1870-1938

TOT: 1870-1913 & 1921-1938, W. G. Hoffmann, *Das Eachstum der Deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts* (Berlin: Springer-Verlag, 1965), Table 134, col. 1, p. 548 (hereafter *Hoffmann*); 1914-1920, interpolated geometrically.

Pa: Agricultural producer price index. 1870-1913 & 1925-1938, *Hoffmann*, Table 137, col. 4, pp. 561-2; 1914-1924, interpolated geometrically.

Pm: Export price index of manufactured goods (includes leather, machinery, chemicals, clothes). 1870-1913 & 1924-1938, *Hoffmann*, Table 151, col. 1, pp. 606-8; 1914-1923, interpolated geometrically.

Ireland 1876-1940

TOT: 1876-1923, no series available; 1924-1940, *Statistical Abstract of Ireland* (1932, 1937, 1942).

Pa: 1876-1901, Michael Turner, *After the Famine: Irish Agriculture, 1850-1914* (Cambridge: Cambridge University Press, 1996), p. 116 for weights and pp. 264-7 for prices of oats, wheat, hay, flax, eggs, butter, pork, beef, mutton and tomatoes (hereafter *Turner*); 1901-1940 , *Nunan*, pp. 71-2, "agricultural products" price index..

Pm: 1876-1930, Great Britains's (Pm) series used as proxy; 1931-1940, import prices index from the *Statistical Abstract of Ireland* (1932, 1937 and 1942).

Spain 1870-1935

TOT: 1870-1913, Leandro Prados de la Escosura, *De imperio a nacion: Crecimiento y atraso economico en Espana 1780-1930* (Madrid: Alianza Editorial, 1988), pp. 257-9; 1913-1935, *Estadísticas Históricas de España, siglos XIX-XX* (Madrid: Fundación Banco Exterior, 1989), Table 8.6, pp. 352-3.

Pa: Leandro Prados de la Escosura, *Output and Expenditure in Spain, 1850-1980* (Madrid: Fundacion Banco Exterior, forthcoming 1999), Table C.8 (hereafter *Prados*).

Pm: *Prados*, Table C.8.

Sweden 1870-1930

TOT: *Kindlberger*, Table 2-1, pp. 12-13.

Pa: Pa was constructed by linking the various agricultural deflator series in O. Krantz and C. A. Nilson, *Swedish National Product 1861-1970* (Kristianstad: CWK Gleerup, 1975), pp. 105, 111, 117, 124 and 131 (hereafter *SNP*).

Pm: Pm was created by linking the various manufacturing deflator series in *SNP*, pp. 107, 113, 118, 126 and 133.

United States 1870-1940

TOT: J. G. Williamson, *American Growth and the Balance of Payments 1820-1913* (Chapel Hill, NC: University of North Carolina Press, 1964), Table B.4, p. 262.

Pa: Farm products prices. 1870-1890, *Historical Statistics of the United States* (Washington, D.C.: Bureau of the Census, 1976), series E43, p. 201 (hereafter *HSUS*); 1890-1940, *HSUS*, series E42, p. 200.

Pm: 1870-1880, *HSUS*, consumer price index: all items less food, series E175, p. 212; 1880-1890, *OTW*; 1890-1926, wholesale price index: manufactured commodities, *HSUS*, series E89, p. 203; 1926-1940, wholesale price index: all commodities other than farm products and foods, *HSUS*, series E41, p. 200.

Uruguay 1870-1940

TOT, Pa and Pm all from personal correspondence with Luis Bertola.

Burma 1886-1923

TOT: 1886-1915, M. Shein, *Burma's Transport and Foreign Trade (in relation to the economic development of the country) 1885-1914* (Rangoon: University of Rangoon Press, 1964), Table 1.C, pp. 223-5, 232-3 (hereafter *Shein*), price of total exports/price of total imports; 1915-1923, Thailand's series Pexp/Pimp used as proxy.

Pa: 1886-1913, Teruko Saito and Lee K. Kiong, *Statistics on the Burmese Economy, the 19th and 20th Centuries* (Singapore: Institute of Southeast Asian Studies, 1999), wholesale paddy prices in Rangoon, Table II-10, p. 98, with geometric interpolation between every five years reported in the source (hereafter *The Burmese Economy*); 1913-1923, *The Burmese Economy*, Table II-10, p. 98, the annual export price of rice.

Pm: 1886-1915, total manufactures import price index, *Shein*, pp. 223-5, 232-3; 1915-1923, Thailand's Pimp series used as proxy.

Egypt 1885-1940

TOT: 1885-1940, B. Hansen and E. F. Lucas, "Egyptian Foreign Trade, 1885-1961: A New Set of Trade Indices," *Journal of European Economic History* 7 (Fall/Winter 1978), Tables 1a and 1b, pp.450-53, export and import prices indices calculated as PFSH/QFSH, where FSH denotes a Fisher index (hereafter *Egyptian Foreign Trade*); *Egyptian Foreign Trade*, Table 2, p. 435. .

Pa and Pm: no series available.

Japan 1885-1938

TOT: *Choki Keizai Tokei (Estimates of Long-Term Economic Statistics of Japan Since 1868*, hereafter *LTES*) *Volume 8* (Tokyo: Toyo Keizai Shinposha ,1967), Table 18, col. 3, p. 212.

Pa: Price index of agricultural products, all commodities. *LTES*, col. 4, p. 165.

Pm: Linked from *LTES*, "All Manufacturing" columns on pp. 195, 197, 200, 203, 207. "All Manufacturing" includes textiles, chemicals, paper products and excludes mining.

Korea 1910-1940

TOT: T. Mizoguchi, "Foreign Trade in Taiwan and Korea under Japanese Rule," *Hitotsubashi Journal of Economics* 14 (February 1974), p. 41.

Pa: S.-C. Suh, *Growth and Structural Changes in the Korean Economy, 1910-1940* (Cambridge, Mass.: Council on East Asian Studies, Harvard University, 1978), Table A-11, p. 169 (hereafter *Suh*).

Pm: *Suh*, Table A-11, p. 169.

Punjab 1870-1940

We have made an effort here to break off the Punjab from India at large. At its peak in the 1890s, food grains were only about one fifth of Indian exports (K. N. Chaudhuri, "Foreign Trade and Balance of Payments 1757-1947," in D. Kumar, ed., *The Cambridge Economic History of India: Volume 2: c. 1757-c.1970* (Cambridge: Cambridge University Press, 1983, hereafter *CEHI*), Table 10.11, p. 844). Burmese rice was a good share of those food grain exports, of course, but wheat typically accounted for about half of the total by the 1880s and 1890s. Wheat growing was concentrated in the Gangeatic plain and in the northwest (B. R. Tomlinson, *The New Cambridge History of India: III, 3: The Economy of Modern India 1860-1970* (Cambridge: Cambridge University Press, 1993,hereafter *NCHI*), Figure 2.1, p. 39), with the Punjab becoming an increasingly important producer. The price boom induced by transport cost improvements (Chaudhuri, in *CEHI*, p. 850; Tomlinson, *NCHI*, Figure 2.3, p. 56) in turn induced irrigation and new land additions in the Punjab (E. Whitcombe, "Irrigation," in *CEHI*, pp. 685 and 711-717) and settlement. Thus, the export price that mattered for the Punjab was wheat and related grains. However, we assume that the all-India import and non-agricultural prices reported below applied to the Punjab as well.

TOT: no series available for the Punjab; we use Pa/Pm.

Pa: 1900-1940: The series 1900-1939 is a weighted average of four grain prices (wheat, bajra, gram, barley) in D. Narain, *Impact of Price Movements on Areas Under Selected Crops in India 1900-1939* (Cambridge: Cambridge University Press, 1965, hereafter *Narain*), Appendix Table 1, p. 163, where the weights are an average of the 1891/2 and 1941/2 acreage of these four as a percent of the total across the four (wheat 54.8; bajra 20.7; gram 16.6; barley 7.9: from G. Blyn, *Agricultural Trends in India, 1891-1947: Output, Availability and Productivity* (Philadelphia: University of Pennsylvania Press, 1966, hereafter *Blyn*), pp. 321-2). The series was extend to 1940 by using the trends in "agricultural prices" in M.

McAlpin, “Price Movements and Fluctuations in Economic Activity (1860-1947),” in *CEHI*, Appendix Table 11A.1, col. 2, p. 904.
Pa: 1873-1900: The series is a weighted average of the same four grain prices from Department of Commercial Intelligence and Statistics, *Index Numbers of Indian Prices 1861-1926* (Calcutta: Government of India Printing Office, 1928), Summary Table III, p. 3. The acreage weights are for 1891/2, and taken from *Blyn*, pp. 321-2 (wheat 53.2; gram 23.2; bajra 12.9; barley 10.7).
Pm: Weighted index of all-India non-agricultural prices from McAlpin, in *CEHI*, Appendix Table 11A.1, pp. 903-4.

Taiwan 1903-1938

TOT: T. Mizoguchi, "Foreign Trade in Taiwan and Korea under Japanese Rule,” *Hitosubashi Journal of Economics* 14 (February 1974) Table 4, p. 41.
Pa: S. Ho, *Economic Development of Taiwan: 1860-1970* (New Haven, Conn.: Yale University Press, Economic Growth Center, 1978), Statistical Appendix, Table A76, p. 421 (hereafter *Ho*).
Pm: *Ho*, Table A76, p. 421.

Thailand 1870-1940

TOT: S. Manarungsan, *Economic Development of Thailand, 1850-1950* (Bangkok: Institute of Asian Studies, Chulalongkorn University, IAS Monograph No. 042, 1989), Table A.4, pp. 215-6 (hereafter *Manarungsan*). TOT calculated as Pexp/Pimp, where Pexp=export price for rice, Pimp=grey shirting price (imported textiles).
Pa: C. D.Cowan, ed., *The Economic Development of Southeast Asia* (New York: Frederick A. Praeger, 1964), Appendix A, col. 4, pp. 121-2. Pa was constructed by using the price of rice (baht per picul).
Pm: Grey shirting price (imported textiles) taken as a proxy from *Manarungsan*, pp.215-6.

3. Factor Endowments: Land and Labor

Except for the countries and periods that follow below, the land and labor data (underlying the land-labor ratios) are taken from common sources.

A common source for the population data is Arthur S. Banks, *Cross-National Time-Series 1815-1973* (Cambridge, Mass.: MIT Press, 1976), hereafter referred to as *Banks*. Alternatively, we also use Angus Maddison, *Monitoring the World Economy, 1820-1992* (Paris: OECD Development Centre Studies, 1995), hereafter *Maddison*. Population breakdown by age and sex, as well as land in agriculture, are mostly taken from one of Brian R. Mitchell’s volumes: *International Historical Statistics: Europe, 1750-1988*, 2nd ed. (New York: Stockton Press, 1995), hereafter *IHSE*; *International Historical Statistics: The Americas and Australasia* (Detroit, Mich.: Gale Research, 1988), hereafter *IHSAA*; and *International Historical Statistics: Africa, Asia, and Oceania, 1750-1988*, 2nd ed. (New York: Stockton Press, 1995), hereafter *IHSAAO*.

Mitchell also reports labor force estimates but we are doubtful about their quality. Instead, we estimate the labor endowment by multiplying the share of the population (male and female) in the age group 15-64, available in the Mitchell volumes, times the total population estimates in *Banks*. Thus, the labor force estimate is for the economy as a whole, not just agriculture, since our purpose is to estimate economy-wide endowments, not intensification in agriculture. We are aware that the labor participation rate of children in low-income societies can be fairly high: in 1950, it was 36.1 percent in Asia among children 10-14 years old (K. Basu, “Child Labor: Cause, Consequence, and Cure, with Remarks on International Labor Standards,” *Journal of Economic Literature* 37, September 1999, p. 1087). Still, we believe the demographic data give us better estimates of the labor force than do Mitchell’s direct estimates. Also, the population age distribution information is only for infrequent census dates, so we must interpolate (geometrically) in between.

Unless otherwise note, the land data are in hectares and include where possible both arable and pasture.

The countries and periods which were taken from sources other than *Banks*, *Maddison* and the Mitchell volumes are:

Britain 1870-1936

Land: Acreage in crops, Great Britain, *ABHS* , pp. 78-79.

Ireland 1870-1940

Land: 1870-1914, *Turner* (1996), pp. 231-2, land in total crops; 1915-1924, interpolated geometrically; 1925-1940, land in all crops, fruit and hay, the *Statistical Abstract of Ireland* (1932, 1937 and 1942).

Spain 1880-1935

Land: Background data to P. O'Brien and L. Prados, "Agricultural Productivity and European Industrialization, 1890-1980," *Economic History Review* 45 (1992), pp. 514-36, supplied by personal correspondence by Leandro Prados. We apply geometric interpolation between Prados' 20-year benchmarks, and assume that 1880-89=1890.

Burma 1870-1940

Land: 1890-1940, from *The Burmese Economy*, Table II-7, pp. 76-7, paddy acreage in lower and upper Burma; 1870-1889, same source, but total paddy acreage in lower Burma only, linked to 1890-1940 series.

Punjab 1870-1940

Land 1892-1940. The source reported the data in fiscal years (e.g., 1891/2), and these were converted to calendar years by two year averaging (e.g., average of 1891/2 and 1892/3 is 1892); from *Blyn*, Appendix 46, pp. 321-2, hereafter *Blyn*. Acreage in all crops, of which food grains were 90.7% in 1891/2, 85.2% in 1911/2, and 83.2% in 1941/2. In 1891/2, wheat was in 36.2%, gram 15.8%, bajra 8.8%, barley 7.2%, and maize 11.6%. Acreage in sugar cane and cotton were very small. The figures for 1941/2 were much the same, except cotton was up to 8%, barley down to 3.8% and maize down to 5.9%.

Labor 1892-1941: Total Punjab population at census dates, taken from *Blyn*, Appendix 4D, p. 326. To this we applied estimates of the share total (Indian) population of active age to infer the Punjab labor force at census dates (see above). The years between census dates were filled in by geometric interpolation. Since the Punjab absorbed from the rest of India immigrants who tended to be male and young adult during this period, this may understate any rise in the labor/land ratio.

Land/Labor Ratios 1873-1941: For 1892-1941, we simply took the ratios of the Punjab land and labor figures estimated above. Before 1892, we assumed that Indian land/labor ratio trends applied to the Punjab as well, and linked them to the 1892-1941 series. For Indian land/labor ratio trends, see the introduction to this section above.

The application of Indian relative endowment trends to a frontier region like the Punjab may or may not understate any rise in the labor/land ratio depending of the relative elasticity of land and labor to favorable price shocks facing the region. We do not yet have the data to explore this possibility.

Taiwan 1901-1940

Land: from *Ho*, Table A42, p. 356, "total crop area reported" including for rice, sweet potatoes, soybean, sugar cane, tea, tobacco, peanuts, bananas, pineapple and others. The source reports data every five years, between which we have interpolated geometrically.

Appendix Table 1

Pa/Pm Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	Argentina	Australia	Canada	Uruguay	USA
1870-1874		140.6		67.3	81.6
1875-1879		139.7		66.5	76.4
1880-1884		124.0		65.2	80.8
1885-1889	87.7	136.4		54.0	78.7
1890-1894	77.3	107.1	75.5	64.8	85.0
1895-1899	73.6	118.2	78.0	69.6	82.4
1900-1904	82.6	108.1	81.9	73.4	90.5
1905-1909	97.1	111.8	94.8	83.8	92.7
1910-1914	96.4	108.1	101.4	112.4	100.1
1915-1919	70.2	113.6	107.6	184.2	97.1
1920-1924	76.3	98.7	87.3	139.2	90.7
1925-1929	81.7	94.5	101.5	118.7	97.3
1930-1934	52.7	72.5	75.4	100.0	74.5
1935-1939	60.9	89.3	91.0	115.9	84.2

Period	G. Britain	Denmark	Ireland	Sweden
1870-1874	88.2	98.8	78.4	74.5
1875-1879	98.8	102.5	91.3	81.7
1880-1884	100.8	104.4	93.1	82.1
1885-1889	92.6	96.8	90.4	78.0
1890-1894	93.4	98.1	95.7	85.5
1895-1899	91.3	93.1	100.3	83.3
1900-1904	89.8	92.1	96.2	91.4
1905-1909	88.3	96.7	98.2	99.6
1910-1914	93.5	101.5	98.8	106.6
1915-1919	91.7		94.0	94.6
1920-1924	77.3		77.7	103.4
1925-1929	83.6		82.2	110.8
1930-1934	73.8		76.5	100.1
1935-1939	72.8		76.3	122.9

Appendix Table 1
(continued)
Pa/Pm Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	France	Germany	Spain
1870-1874	87.5	62.6	104.9
1875-1879	94.4	61.1	113.1
1880-1884	99.3	60.6	115.6
1885-1889	94.6	60.8	121.2
1890-1894	92.6	74.1	109.1
1895-1899	90.7	72.0	116.4
1900-1904	87.5	70.9	106.6
1905-1909	88.7	85.9	104.1
1910-1914	95.4	99.8	102.2
1915-1919	71.6	96.6	105.9
1920-1924	50.5	94.7	108.1
1925-1929	54.3	91.9	121.7
1930-1934	79.9	78.4	120.2
1935-1939	74.5	103.4	116.6

Period	Burma	Egypt	The Punjab	Thailand
1870-1874			87.5	66.8
1875-1879			103.7	79.0
1880-1884			84.8	81.4
1885-1889	68.9	75.8	96.8	88.2
1890-1894	67.6	65.1	103.3	92.6
1895-1899	83.0	64.6	130.9	148.4
1900-1904	90.9	81.7	121.6	111.5
1905-1909	98.1	92.5	123.5	96.3
1910-1914	94.4	99.5	109.8	86.2
1915-1919	61.1	69.1	113.7	69.6
1920-1924	95.6	88.2	110.7	66.3
1925-1929		96.4	119.4	96.1
1930-1934		75.7	99.4	81.9
1935-1939		79.9	112.6	90.7

Appendix Table 1
(continued)
Pa/Pm Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	Japan	Korea	Taiwan
1870-1874	86.0		
1875-1879	85.3		
1880-1884	80.6		
1885-1889	76.9		
1890-1894	94.2		
1895-1899	95.6		
1900-1904	92.8		73.5
1905-1909	87.8		71.3
1910-1914	98.3	105.8	103.7
1915-1919	86.1	104.1	82.6
1920-1924	100.9	99.0	50.9
1925-1929	112.0	119.6	57.6
1930-1934	98.5	101.3	62.8
1935-1939	115.2	112.4	69.1

Notes: The Egyptian Pa/Pm series simply repeats the Egyptian Pexp/Pimp series. The Pa/Pm series for Great Britain, Germany, Taiwan and Korea end in 1938, so their last period average is actually 1935-1938. The Burmese averages for 1885-1889 and 1920-1924 are actually 1886-1889 and 1920-1923 respectively, the Taiwanese average for 1900-1904 is actually 1903-1904, and the Japanese one for 1870-1874 is actually 1874. See the appendix notes for sources.

Appendix Table 2

Pexp/Pimp Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	Argentina	Australia	Canada	Uruguay	USA
1870-1874		103.2	63.5	55.7	83.6
1875-1879		105.8	74.9	61.5	90.2
1880-1884		109.3	80.0	73.2	98.6
1885-1889	94.6	103.0	87.7	75.9	97.7
1890-1894	76.8	89.8	92.6	92.7	91.6
1895-1899	73.6	89.1	97.1	89.3	89.8
1900-1904	82.6	97.0	92.9	83.3	99.5
1905-1909	97.1	106.9	95.0	95.6	100.3
1910-1914	97.5	101.6	98.9	113.1	102.9
1915-1919	81.2	94.5	104.9	118.8	121.8
1920-1924	58.7	84.4	90.0	70.5	120.8
1925-1929	76.8	116.1	99.8	95.0	109.3
1930-1934	67.3	76.3	88.4	78.0	135.1
1935-1939	87.8	90.0	89.0	118.0	148.8

Period	G. Britain	Denmark	Ireland	Sweden
1870-1874	92.0	91.3		
1875-1879	84.5	76.8		
1880-1884	80.7	86.8		
1885-1889	84.6	87.3		
1890-1894	91.3	87.1		88.3
1895-1899	94.1	93.7		90.0
1900-1904	99.4	95.2		96.4
1905-1909	97.6	95.8		98.5
1910-1914	98.2	101.4		104.0
1915-1919	108.9	84.2		114.1
1920-1924	130.4	98.9	87.5	133.0
1925-1929	117.7	106.8	92.7	134.3
1930-1934	138.3	100.3	92.7	129.1
1935-1939	134.2	104.1	89.2	134.3

Appendix Table 2
(continued)
Pexp/Pimp Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	France	Germany	Spain
1870-1874	101.6		99.4
1875-1879	100.7		117.4
1880-1884	104.6	131.2	111.7
1885-1889	104.1	125.0	108.2
1890-1894	103.9	124.4	102.6
1895-1899	115.9	124.5	104.4
1900-1904	104.4	117.1	95.8
1905-1909	97.3	105.9	101.5
1910-1914	97.1	98.3	93.7
1915-1919	100.0	87.8	78.0
1920-1924	104.1	81.4	67.3
1925-1929	89.3	105.7	100.6
1930-1934	100.0	137.7	102.0
1935-1939	92.5	129.4	75.1

Period	Burma	Egypt	The Punjab	Thailand
1870-1874			87.5	73.2
1875-1879			103.7	79.4
1880-1884			84.8	90.3
1885-1889	72.3	75.8	96.8	93.1
1890-1894	77.5	65.1	103.3	102.2
1895-1899	89.4	64.6	130.9	135.3
1900-1904	91.3	81.7	121.6	100.4
1905-1909	99.7	92.5	123.5	97.1
1910-1914	104.4	99.5	109.8	85.6
1915-1919	89.5	69.1	113.7	67.5
1920-1924	80.4	88.2	110.7	65.0
1925-1929		96.4	119.4	96.3
1930-1934		75.7	99.4	82.3
1935-1939		79.9	112.6	87.9

Appendix Table 2
(continued)
Pexp/Pimp Ratios for Nineteen Countries, 1870-1940 (1911=100)

Period	Japan	Korea	Taiwan
1870-1874	85.0		
1875-1879	105.1		
1880-1884	109.1		
1885-1889	116.7		
1890-1894	128.1		
1895-1899	131.6		120.0
1900-1904	106.8		113.2
1905-1909	117.4		115.8
1910-1914	93.1	102.7	108.7
1915-1919	88.1	60.7	80.4
1920-1924	119.0	61.6	96.5
1925-1929	103.6	77.6	92.5
1930-1934	81.1	87.7	101.0
1935-1939	64.9	73.2	97.4

Notes: The Punjab Pexp/Pimp series simply repeats the the Punjab Pa/Pm series. The series for Great Britain, Sweden, Germany, Taiwan and Korea end in 1938, so their last period averages are actually 1935-1938. The USA average for 1935-1939 is actually 1935, the Irish average for 1920-1924 is actually 1924, the Swedish average for 1890-1894 is actually 1893-1894, the Burmese averages for 1885-1889 and 1920-1924 are actually 1886-1889 and 1920-1923 respectively, the Korean average for 1910-1914 is actually 1911-1914 and the Taiwanese average for 1895-1899 is actually 1896-1899. The Irish series is indexed 1930=100. See the appendix notes for sources.

Appendix Table 3

Land/Labor Ratios for Nineteen Countries 1870-1940 (1911=100)

Period	Argentina	Australia	Canada	Uruguay	USA
1870-1874		195.1		262.1	99.9
1875-1879		161.6		223.8	112.8
1880-1884	27.5	123.9		195.0	117.9
1885-1889	23.2	137.3	36.9	166.5	115.4
1890-1894	32.8	148.3	38.8	140.4	113.8
1895-1899	60.9	131.6	43.5	123.6	114.5
1900-1904	77.2	114.5	53.1	108.5	110.4
1905-1909	98.7	113.3	71.8	98.6	102.9
1910-1914	99.3	93.7	101.5	106.2	99.7
1915-1919	89.9	86.9	127.0	110.4	98.9
1920-1924	81.1	105.9	161.8	88.0	94.5
1925-1929	83.9	90.0	158.1	82.0	87.4
1930-1934	74.5	82.5	147.0	83.7	81.1
1935-1939	62.1	103.0	135.1	87.9	70.3

Period	G. Britain	Denmark	Ireland	Sweden
1870-1874	220.5	129.9	94.1	101.0
1875-1879	201.8	130.2	92.6	102.4
1880-1884	179.8	130.7	91.0	106.7
1885-1889	160.5	130.4	93.1	115.5
1890-1894	141.6	126.6	91.8	119.6
1895-1899	124.9	119.3	91.0	114.5
1900-1904	114.2	111.1	90.5	109.0
1905-1909	104.8	104.5	93.7	104.1
1910-1914	99.6	98.3	99.5	99.2
1915-1919	100.1	92.2	93.9	94.7
1920-1924	93.7	89.3	84.9	90.0
1925-1929	76.9	85.3	78.5	84.0
1930-1934	70.3	81.5	76.4	76.2
1935-1939	74.2	76.3	74.2	71.5

Appendix Table 3
(continued)
Land/Labor Ratios for Nineteen Countries 1870-1940 (1911=100)

Period	France	Germany	Spain
1870-1874	114.6	134.0	
1875-1879	114.0	134.0	
1880-1884	114.3	133.3	102.3
1885-1889	115.4	130.1	100.2
1890-1894	114.2	124.2	99.3
1895-1899	112.3	118.0	100.3
1900-1904	108.0	112.0	100.8
1905-1909	104.5	104.7	100.6
1910-1914	96.4	99.8	99.5
1915-1919	84.4	85.6	96.8
1920-1924	83.4	70.0	94.1
1925-1929	84.3	73.6	91.3
1930-1934	82.8	71.3	87.3
1935-1939	75.8	67.4	81.6

Period	Burma	Egypt	The Punjab	Thailand
1870-1874			104.0	76.1
1875-1879			104.0	77.7
1880-1884	101.9		100.5	76.1
1885-1889	83.2	109.0	92.1	79.7
1890-1894	92.4	109.0	89.2	84.9
1895-1899	91.3	108.9	72.5	84.8
1900-1904	97.6	105.9	79.3	87.3
1905-1909	100.3	100.3	94.9	95.9
1910-1914	102.3	101.7	100.5	100.3
1915-1919	99.9	98.9	101.4	103.7
1920-1924	98.3	87.8	100.5	109.7
1925-1929	101.8	87.6	97.0	113.4
1930-1934	99.2	83.9	90.7	114.0
1935-1939	95.9	77.8	81.1	111.4

Appendix Table 3
(continued)
Land/Labor Ratios for Nineteen Countries 1870-1940 (1911=100)

Period	Japan	Korea	Taiwan
1870-1874			
1875-1879			
1880-1884	106.7		
1885-1889	109.8		
1890-1894	108.8		
1895-1899	103.5		
1900-1904	99.8		
1905-1909	99.5		92.4
1910-1914	100.0	97.1	99.9
1915-1919	101.1	86.8	100.9
1920-1924	99.1	81.6	100.5
1925-1929	90.7	76.5	99.5
1930-1934	84.1	74.5	97.7
1935-1939	79.6	74.0	100.8

Notes: Taiwanese figure for 1900-1904 is actually 1901-1904. See the appendix notes for sources.