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"Economic Integration and Convergence:
An Historical Perspective"

by
Kevin O'Rourke

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Section 1. Introduction

Will increased European integration produce regional convergence, or will it exacerbate the differences between rich and poor regions within the Community? In the mid-1980s, when the Single Market programme was first being discussed, Brussels was remarkably silent on this issue. The emphasis in the Cecchini Report was on the aggregate gains of greater economic integration to the Community as a whole, and overall gains remained the focus of later studies, such as Baldwin (1989). Indeed, the index to Emerson et al. (1988) does not contain a single entry under the heading 'region'!

This neglect was politically understandable, of course. An emphasis on the regional distribution of overall gains might have prompted speculation that some regions would be net losers; where such regions accounted for entire countries (as in the case of Ireland), crucial popular referenda or parliamentary votes might have been lost. Stressing EC-wide effects would clearly make sense in such circumstances.

The situation today is drastically different, both politically and intellectually. Politically, the 1987 Single European Act (SEA) introduced as an explicit goal of EC policy the reduction of regional inequality; associated reforms of the Community's regional aid programmes led to a doubling in real terms of the Structural Funds between 1987 and 1993; the Edinburgh Summit of 1992 established 'Cohesion' funds for the four poorest EU members. The amounts involved are substantial; for example, current plans envision Ireland

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receiving ECU 1.3 bn. under the 'cohesion' heading, and ECU 5.62 bn. under the 'structural funds' heading, between 1994 and 1999. This amounts to a transfer of 18% of 1994 GNP over a 6 year period.

Such aid can be seen as reflecting a belief that market forces on their own will not enable poor regions to converge on richer regions. The timing of key reforms -- associated as they were with the 1992 project (real integration) and Maastricht (monetary integration) -- also suggests that some may have viewed regional aid as a necessary side-payment to poorer countries, who might otherwise have lost from greater economic integration. Americans may hear a 'giant sucking sound' when they look across the Rio Grande to the Mexican periphery and contemplate NAFTA, but to many in the European periphery, it is the core which seems an economic whirlpool, sucking in capital and jobs. It seems that the regional effects of globalization have now become a political concern in both rich and poor countries.

Just as trade follows the flag, so trade theory has followed politicians in worrying about the regional impact of economic integration. The incorporation of increasing returns in formal models, be they in the Helpman/Krugman new trade theory tradition, or in the economic geography literature, has changed the way theorists view the effects of globalization. The literature always realized that globalization would involve losers as well as winners *within* countries; but absent terms of trade effects, the presumption was that all regions would gain in aggregate terms from commodity market

integration. This presumption does not hold in the new theory. Increasing returns have also been introduced into growth models, enabling theorists to identify dynamic regional effects of economic integration which are again ambiguous.

The big implication of all these theoretical developments is that whether economic integration between rich and poor regions produces convergence or divergence is a strictly empirical matter: theory alone cannot tell you anything. In such circumstances, history may provide a useful guide to today's policy dilemmas. That is the approach taken by this paper, which focuses mainly on the late 19th century. Section 2 provides an overview of the above-mentioned theoretical developments which inform the contemporary debate about globalization and convergence, while Section 3 reviews current empirical work on the subject. Sections 4 and 5 examine the extent to which static trade models help us understand the impact of trade, migration, and international capital flows on factor prices; they argue that the Heckscher-Ohlin world view is more useful in interpreting history than is sometimes thought. Section 4 asks whether late 19th century commodity market integration produced factor price convergence, as the Stolper-Samuelson theorem suggests. Section 5 examines international factor flows in the late 19th century, and argues that these took place for the reasons, and had the economic impact, that traditional theory suggests. Section 6 concludes, by looking briefly at the current debate about the impact of trade on skill differentials in OECD economies, and suggesting a research agenda for the future.

Section 2. Economic integration and convergence: theory

The implications of traditional trade theory for the link between economic integration and convergence are straightforward. The argument is seen most clearly when applied to real wages. First, consider the impact of commodity market integration. The Heckscher-Ohlin paradigm argues that countries export commodities which use intensively the factors with which they are well endowed while they import commodities which use intensively the factors with which they are poorly endowed. Let falling transport costs or trade liberalisation tend to equalize prices of traded commodities. Countries will now export more of the goods which exploit their favorable factor endowment. The demand for the abundant and cheap factor booms while that for the scarce and expensive factor falls. Thus, commodity price convergence tends to produce factor price convergence. In the labour-abundant periphery, real wages will rise, while they will fall (*ceteris paribus*) in the labour-scarce core.

Of course, labour or capital mobility will also do the trick, as Robert Mundell (1957) recognised. Labour will flow from the periphery to the core in search of higher wages, raising peripheral wages and lowering core wages; capital will flow from the core to the periphery in search of higher returns, again lowering core wages and increasing peripheral wages. In the language of earlier debates on the same themes, these 'spread' effects will all serve to erode factor price differences between regions.

Moreover, these standard trade-theoretical arguments all have implications for the convergence debate, a debate usually concerned with the convergence properties of aggregate indicators like GDP per worker.¹ Let Y be GDP, P be the price level of GDP, v_i be the endowment of factor i (where $v_L = L$, the endowment of labour), and w_i be the price of factor i (where $w_L = W$, the wage). The factor income definition of GDP implies that

$$Y/L = (W/P) \{1 + \sum_{i \neq L} (w_i v_i) / (w_L v_L)\} \quad (1)$$

Thus convergence in GDP per worker is accounted for by three forces. First, convergence in relative factor endowments per worker, (v_i/v_L) ; this is the mechanism emphasised by the Solow growth model, but open economy forces such as migration and international capital mobility will also bring it about. Second, convergence in relative factor prices, (w_i/w_L) , which may again be a consequence of Solovian accumulation forces, but may also be due to open economy Heckscher-Ohlin forces. Third, real wage convergence, which again may be due to either closed economy accumulation forces, or to open economy, factor and commodity market integration forces. Traditional trade theory thus predicts a strong link between economic integration and convergence, whether the latter be expressed in terms of factor prices or GDP aggregates.

¹ The following section draws on O'Rourke, Taylor and Williamson (forthcoming).

Backwash effects: static arguments

The literature disputing the essentially optimistic conclusions of the Heckscher-Ohlin model is not, as is sometimes claimed, of recent origin; rather, it dates back at least forty years. Moreover, the basic notion that cumulative processes (associated, for example, with economies of scale) may ensnare backward regions in poverty traps, and that these cumulative processes may be exacerbated by economic integration with the core, has been a feature of the literature during the entire period. Indeed, in some cases new trade theory, by formalizing earlier intuitions, has muted the pessimism of Myrdahl, Kaldor et al. Take for example the old argument that external economies of scale can imply that a backward region loses by opening itself to trade with a larger, more developed nation. The argument is that peripheral industries will be unable to compete; as core industries expand at the expense of the periphery, the cost advantages of the core increase rather than decline; inter-regional mobility of capital and labour will in such circumstances only exacerbate the problem.

This all sounds very gloomy from the perspective of the periphery, which might end up losing all (external) increasing returns industries. But from a welfare perspective, Ethier (1982) shows that the small region² may still gain from trade, and indeed that this is more likely the smaller it is, and the stronger are the economies of scale. This result is due to the fact that concentrating production in one location confers

² Which we may think of as the peripheral country.

benefits on all consumers where that production is subject to increasing returns. The periphery is better off consuming goods produced cheaply in the core than itself producing those goods inefficiently.

Similarly, the work of Helpman and Krugman (1985) on trade subject to increasing returns more generally also makes it clear that increasing returns on their own do not prevent trade from leading to convergence. It is of course true that the aggregate welfare effects of commodity market integration are ambiguous when trade is motivated by increasing returns, whether those returns be internal or external to the firm. Trade allows all countries to reap further economies of scale; consumers thus benefit from lower prices, and possibly from greater variety; producers may gain from increased export opportunities; but they may also lose from increased competition. However, the key relevance of the book to the subject of convergence is that it shows clearly that increasing returns and imperfect competition on their own do not rule out factor price equalization: once again, careful formalisation shows that increasing returns on its own does not necessarily have the stark regional implications suggested by earlier theorists, or indeed by some contemporary commentators.

The new trade theory literature was not, however, cast in a core-periphery framework, possibly because the big stylized fact it was designed to explain was the large amount of trade between developed countries. In contrast, the economic geography literature not only deals explicitly with economic

integration between rich and poor regions, but focuses on the implications for convergence, and is not always optimistic. The key to this literature is that it not only assumes increasing returns to scale, but introduces transport costs. Using a variety of models, Krugman and Venables (1990, 1995) explore the interactions between market size, economies of scale, and transport costs, and derive their now-famous U-shaped curves relating transport costs, on the one hand, to industry location and relative wages on the other. With economies of scale in manufacturing, there is an incentive for production to concentrate in one region. If manufacturing is labour-intensive, the low-wage periphery should have a comparative advantage in it and export it under free trade. If trade barriers or transport costs are very high, shipping the good between markets will be expensive, and production will take place in both the core and the periphery. However, if trade barriers or transport costs are at an intermediate level, it will be too expensive to produce in the periphery for consumption in the larger core market; but efficient to produce in the core for the small peripheral market. Starting from very high trade barriers, liberalisation first leads to peripheral production (and wages) falling, before leading to both rising again. Market integration may involve an initial phase of divergence, followed by one of convergence: initially the core benefits and the periphery loses, while eventually the periphery gains and the core may lose.

The theory is empirically suggestive. As Barry (forthcoming) notes, it offers one way of interpreting the

evidence presented by Williamson (1964), who showed that in many countries long run regional inequality has increased before declining again. Furthermore, as Krugman and Venables note, their theory offers the possibility of reconciling Myrdahl and Ross Perot: arguably the former was describing life in the initial phase of globalization, while the latter is concerned with life in the subsequent phase. What such a theory cannot do, however, is reconcile Ross Perot with peripheral pessimists. Integration benefits either the core or the periphery; both cannot lose (although both may gain).

Backwash effects: dynamic arguments

Models endogenising the long-run growth rate, which have been developed in the past decade, are capable of deriving long-run growth effects of a number of policies, including trade policy. A number of papers have explored the implications of liberalization for the relative growth rates of rich and poor countries. Several have concluded that economic integration can produce divergence: a common feature is that poor countries may reap the traditional static benefits of moving to freer trade, but that these static benefits may be overwhelmed by long-run dynamic losses. Conversely, other papers argue that trade liberalisation should boost everyone's long run growth rate.

A key way in which these papers differ is how they characterise the core and the periphery, or rich and poor countries. The periphery may be distinguished by a lower

initial level of technology; or by a relative scarcity of human capital; or simply by a smaller size.³ The papers also differ in how they generate endogenous growth. The differences matter.

For example, Stokey (1991) distinguishes countries by their initial endowments of human capital. Individuals invest in human capital, which is useful in that it enables individuals to produce higher quality goods. Effectively, human capital is useful in that it directly produces final output. Endogenous growth arises from assuming that the marginal product of investing in skill formation rises with the stock of knowledge, which depends on previous human capital investments. The mechanism of growth is investment in skills.

In such a scenario, when an LDC (with scarce human capital) trades with a human-capital-abundant DC, the Stolper-Samuelson mechanism ensures that returns to skill in the LDC are lowered. This reduces the incentive to acquire skills, and hence the LDC growth rate. Similarly, the DC's growth rate increases: trade leads to divergence.⁴

However, such an outcome depends on the specification of the growth process. Grossman and Helpman (1991, Chapters 6, 9) assume that human capital is useful in that it is an input into R&D, rather than being an input into final output

³ This may be a plausible way of characterising the European periphery, but at the world level, the South is clearly not small. The appropriate model clearly depends on the context.

⁴ Trade may still benefit LDCs overall, due to static welfare effects. But it seems likely that DCs will benefit more, under the scenario just outlined.

directly. Moreover, they take the endowment of human capital as exogenous. In such a scenario, trade which lowers LDC skilled wages, and increases DC skilled wages, boosts LDC technical progress, and lowers DC technical progress, in that the cost of innovation declines in the LDC (and increases in the DC): trade leads to convergence.

Grossman and Helpman reach a similar conclusion regarding international capital flows (Section 6.4). If the LDC is capital scarce, then capital flows will lower LDC interest rates, spurring LDC innovation; by the same token, DC interest rates will rise, retarding DC innovation.

On the other hand, trade based on differences in factor proportions will lead the LDC to specialise in labour-intensive goods (traditional manufacturing), while the DC will specialise in human-capital-intensive (high tech) goods. If only the latter are characterised by technical progress, trade may slow the overall growth rate in the LDC: even though technological progress in the high-tech sector has increased, the weight of that sector in total output has declined. Similarly, the DC might experience an increase in its overall growth rate: even though technological progress in its high-tech sector has declined, the weight of that sector has increased (Section 9.4). These arguments of course rely on assumptions about the relative technological progressiveness of labour- and skill-intensive manufacturing, which may seem intuitive, but are typically not supported with empirical evidence.

Even in a fairly simple framework, then, it appears that

trade has ambiguous effects on the incomes of LDCs *vis à vis* DCs. This ambiguity emerges elsewhere in the literature. Young (1991) distinguishes DCs from LDCs on the basis of their initial technologies, in a model where growth occurs due to learning by doing (whose potential is pre-ordained for each commodity) across a continuum of commodities. Like Grossman and Helpman, he focuses on what Davis (1992) labels the *composition* effects of trade: the LDCs specialise in goods where learning by doing has already been largely or completely exhausted, whereas DCs specialise in commodities with lots of potential for further learning by doing. The net result is that while both regions enjoy static gains, LDC growth rates will tend to fall, and DC growth rates to rise: trade leads to divergence. By contrast, Davis focuses on the *concentration* effects of trade. Let innovation be determined by investment (as in Grossman and Helpman). Moreover, let it take place in more than one sector (unlike Grossman and Helpman), and let it take place subject to sector-specific increasing returns to scale. Trade leads both regions to concentrate their R&D resources on a single commodity (or a subset of commodities) rather than spreading those resources across many sectors. Given increasing returns to R&D, this will lead to growth rates in both regions increasing (at least where the regions are arbitrarily similar initially). Trade can have a symmetric impact on different regions' growth rates, rather than an asymmetric effect.

Moreover, trade liberalisation is trade creating in both regions: if more trade implies more innovation, through any

one of a number of mechanisms (all of which speed the international flow of information) then trade increases the growth rate everywhere [Grossman and Helpman (1991, Section 6.5)]. Similarly, Rivera-Batiz and Romer (1991) find that trade may boost growth in two similar regions, due to the exploitation of economies of scale in R&D, while disembodied information flows also boost growth everywhere.

Finally, note that if knowledge spillovers are only national in scope, then trade may retard innovation in one country (rather than raise it everywhere, as is the case with international spillovers). The argument is similar to the national external economies of scale argument encountered earlier. Specifically, trade may retard growth in countries with a low initial level of technology (who are forced out of high-tech production due to their initial cost disadvantages); or in small countries (for the same reason). Nonetheless, consumers in laggard countries still benefit from innovations made by the leaders [Grossman and Helpman (1991, Chapter 8)].

Summary

There are thus an impressive array of possible theoretical outcomes. Recent theory has clearly demonstrated that, contrary to popular belief, increasing returns, endogenous growth and the like are not on their own incompatible with trade leading to convergence. However, arguments can easily be erected supporting the opposite view that trade leads to divergence. Key issues in resolving the dispute include: whether transport costs matter a lot or a

little; whether knowledge spillovers are national or international in scope; and whether innovation is possible in all sectors or only certain sectors. Another key question is: to what extent are the predictions of the (static) Heckscher-Ohlin model born out by the evidence? In particular, to what extent does commodity price convergence imply factor price convergence, as the theory suggests? If these Stolper-Samuelson effects are born out by the evidence, it is more likely that the convergence conclusions of traditional neo-classical theory are valid.⁵

In the end, these issues can only be resolved empirically.

Section 3. Trade and convergence: recent evidence

Section 2 showed that theory is agnostic on the issue of whether economic integration produces convergence or divergence. What does the evidence show?

The simplest way to tackle the question is to identify phases of economic integration and disintegration in the world economy, and see if these periods were associated with either convergence or divergence. Surprisingly little work has been done along these lines, for at least two reasons. First, the post-1945 period was predominantly a liberal period; for real economic disintegration, we have to go back to the interwar

⁵ Although Stokey (1991) would clearly argue otherwise.

period, which is not covered by such popular data sets as the Penn World Tables.⁶ Second, a lot of work on convergence has related growth over a long period (1950-1988, say) with initial income; that is, it has focused on beta-convergence. By so doing, it has neglected a lot of data on what happened in the interval between the initial and terminal years.

If we split the post-war data into 3 periods, 1950-1960, 1960-1973, and 1973 to the present, we see that beta-convergence was strongest in the 1960s, a period of great intra-European liberalisation.⁷ Most notably, peripheral countries, which had remained relatively autarchic during the 1950s, underperformed in that decade, but participated fully in the European convergence experience after 1960, by which time they were embarking on liberalisation programs. The causes of the slow-down in convergence after 1973 remain unclear; flawed macroeconomic policy in countries such as Ireland in the wake of the oil shocks suggests itself as a likely candidate.

Several studies have noted that the sigma-convergence experienced within the OECD club slowed or came to a halt in the 1980s [e.g. essays by Abramowitz and Baumol in Baumol et al. (1994), Ben-David (1993)]. For example, de la Fuente and Vives (1995), who focus on Europe, show that regional inequality increased during the 1980s [drawing on Esteban

⁶ Although several authors, such as Abramowitz (1986), Baumol (1986), Baumol et al. (1989), De Long (1988), several authors in Baumol et al. (1994), and above all Maddison (1982, 1991) do examine the longer-run evidence.

⁷ O'Rourke and Ó Gráda (1995).

(1994)]. However, this was due to an increase in regional inequality within countries: inequality between countries continued to fall. This is of course relevant to the question of whether there should be transfers between national governments.

Williamson (1995) has produced the most compelling long run evidence to date on this subject, at the expense of focusing on real wages (for which good data are available) rather than GDP per worker. The data run for 150 years, long enough to be driven primarily by real rather than by macroeconomic forces. He finds substantial convergence between 1870 and 1913, a period of dramatic globalization (sections 4 and 5). In the interwar period, when international commodity and factor markets broke down, convergence ceases, and yields to divergence. Finally, convergence resumes after 1945, in tandem with a liberalisation of international commodity and capital markets.

The most sophisticated study in this tradition of the post-war evidence is Ben-David (1993), who focuses explicitly on the EEC. He shows that there was substantial convergence between the original EEC 6 after 1950 (which again ceased in the 1980s) and argues that there is a link between intra-EEC trade liberalisation and this convergence. For example, dispersion between Ireland, the UK and Denmark increased until the mid-1960s, when they started to liberalise *vis a vis* each other; dispersion between the three declined after 1973, when they joined the EEC.

However, Ben-David's argument suffers from an obvious

flaw: it is entirely *post hoc ergo propter hoc*. Moreover, his argument that post-war convergence must have been due to liberalisation, as there was no convergence prior to 1945, is incorrect, as Williamson (1995) shows. These correlations are fascinating and suggestive, but we need rigorous model-based analysis if Ben-David's argument is to be made convincingly.

Growth regressions in the tradition of Barro (1991), Dowrick and Nguyen (1989), Mankiw et al. (1992), and many others, offer a distinct improvement on the simple correlations reported above, in that they attempt to control for as many other variables influencing growth rates as they can. Studies such as De Long and Summers (1991) have typically found that openness is positively associated with growth. Sachs and Warner (1995) are however more directly relevant to this paper. It is a commonplace that the world as a whole does not display convergence; however, when you examine only those countries pursuing open trade policies as well as appropriate political policies, Sachs and Warner find that there is a strong tendency to convergence. Moreover, openness turns out to be a more important determinant of convergence club membership than politics.

This finding is striking in its implications, and suggests many historical questions. One such question concerns the late 19th century. LDCs were unable to participate in a liberal international economic order in the interwar period, and many LDCs chose not to do so after 1945. What was the growth performance of LDCs prior to 1914, when many were closely linked to the DCs through trade and factor

flows? If they were converging on the DCs during this period, it would constitute powerful evidence in support of the Sachs-Warner position.

However, there are two problems with these cross-country studies. First, even if we find that openness is statistically related to growth, or convergence, it remains unclear precisely through what mechanisms the relationship is operating. There are many dimensions of openness, and many ways it can promote convergence: we would like to know whether openness is promoting convergence as a result of Heckscher-Ohlin effects, capital or labour flows, technology transfer, or other reasons (for example, the cost of R&D mechanism identified by Grossman and Helpman). Sachs and Warner also show that openness is strongly related to political stability: could it be that the latter is really what matters?

Second, and more fundamentally, we lack a satisfactory index of the level of protection. As is well known, a classic index number problem arises: take the following trade-weighted average tariff

$$t = \frac{\sum M_i t_i}{M} \quad (2)$$

where M_i is the import of good i , t_i is the tariff levied on good i , and M is total imports. The problem with this measure is clear: as the tariff on good i is increased, the weight on good i declines. In the extreme case, if a tariff is raised so high that imports are excluded, the weight drops to zero, and the tariff no longer contributes to the index. When

protection largely takes the form of quotas or VERs, the measurement problems are even more severe.

Other attempts to measure the openness of national economies have been no more satisfactory. For example, some researchers have used the ratio of exports, or imports, to GDP, as a measure of openness. This measure is clearly unconvincing. The equilibrium ratio of trade to GDP might be low for a particular economy in free trade. More recently, Edward Leamer and others have developed a measure of trade openness based on a Heckscher-Ohlin empirical trade model.⁸ If trade patterns for a country do not conform with the predictions of the model, this is taken as evidence of protection. The problem with this index of protection is also obvious: the Heckscher-Ohlin model used may not adequately describe late 20th century trade patterns.

Finally, many studies have resorted to the use of discrete classifications of countries ('strongly outwardly oriented', and so on) to evaluate the effects of openness on performance. These classifications have been adopted largely because of the growing importance of non-tariff barriers in overall trade policy. This makes it impossible to estimate the elasticities we are most interested in, and introduces the possibility of bias on the part of the classifier. Two recent surveys, Capie (1994) and Edwards (1993), indicate clearly how big an obstacle the protection measurement problem has been to

⁸ See Leamer (1988), or Edwards (1992) for an application.

research in this area.⁹

Finally, a recent paper by Barry (forthcoming) takes an entirely different approach to the above-mentioned studies. It approaches the issue of whether integration produces convergence or divergence by asking whether we in fact observe the mechanisms which proponents of the divergence thesis rely on to make their arguments. Focusing on Ireland, Barry asks whether in the wake of Ireland's entry to the EEC in 1973, we observe reductions in: human capital accumulation; industrial productivity growth; R&D activities; the output of increasing returns industries. In each case the answer is "no"; indeed, Barry notes that according to Neven (1990) Ireland has a revealed comparative advantage in human-capital-intensive goods! Barry argues that increasing levels of foreign direct investment help explain why the gloomier predictions of the backwash theorists fail so spectacularly in the Irish case.

Section 4. The late 19th century: were Heckscher and Ohlin right?

The previous section argued that most studies on the

⁹ James Anderson and Peter Neary (1994) have recently proposed a new index of protection, the trade restrictiveness index (TRI). The TRI is defined as the uniform tariff which would have the same static welfare effect as the structure of tariffs and quotas actually in place. Unlike previous ad hoc measures, the TRI makes theoretical sense. However, by definition the TRI can only be measured within the context of a particular general equilibrium model; and O'Rourke (1994) shows that in at least one historical episode, the TRI is extremely sensitive to the specification of the model used to evaluate it. Nevertheless, the development of sound, theoretically based, indices of protection for many countries is clearly a major research priority.

links between growth and convergence play insufficient attention to the precise mechanisms through which globalisation affects incomes in different regions. The following two sections attempt to remedy this, by reporting on a large body of work which has emerged in the last five years linking globalisation and convergence in the late 19th century, and in particular the period 1870-1913. The literature was in large part sparked by Williamson's (1995) finding that the late 19th century was a period of substantial real wage convergence; in addition to Williamson, the work has involved (among others) Timothy Hatton, Alan Taylor, and myself.

The late 19th century was a period of unprecedented globalisation. Europeans emigrated to the New World in numbers not surpassed before or since [Hatton and Williamson (forthcoming)]; France, Germany, and above all Britain exported vast amounts of capital, at a time when global capital markets were as integrated as in the 1980s [Edelstein (1982, Zevin (1992))]; and trade boomed as transport costs plummeted [Harley (1986), North (1958), O'Rourke and Williamson (1994)]. To what extent do these forces explain late 19th century convergence? In this section I examine the impact of commodity market integration and Heckscher-Ohlin forces, while in the next section I outline the impact of factor market integration.

Before quantifying the impact of commodity market integration, note that there is evidence of widespread factor price convergence for 1870-1913. O'Rourke, Taylor and

Williamson (1996) construct indices for the ratio of wages to land rents (or land values) in eleven countries, four in the New World (Argentina, Australia, Canada and the US) and seven in the Old World (Britain, Denmark, France, Germany, Ireland, Spain and Sweden). In the New World, land was abundant and labour scarce: consequently wage-rental ratios were high. In the Old World, labour was abundant and land scarce, and wage-rental ratios were low. Trade between Old World and New, which involved Europe exporting manufactures and importing food, should have led to European rents falling and New World rents rising. Did it?

Between 1870 and 1913, the wage-rental ratio boomed in the Old World, and plummeted in the New World: clear evidence of factor price convergence.¹⁰ Moreover, within the Old World, the wage-rental ratio increased more in countries which maintained a basically free-trade stance throughout the period than in countries which resorted to protection. Again, more straws in the wind: can we make these connections between trade and factor price convergence precise within the context of well-specified economic models?

O'Rourke and Williamson (1994) examine the impact of commodity market integration between two key countries, Britain and the US. First, they establish the extent of commodity market integration. The classic example is offered by the grain market. Wheat prices in Liverpool (the major

port handling Britain's grain trade) exceeded wheat prices in Chicago by 60.3 percent in the three years centered on 1870, while they exceeded Chicago prices by only 14.9 percent in the three years centered on 1912. There was also price convergence for beef, pork, bacon, mutton, butter, bar iron, cotton textiles, coal, copper, hides, wool, tin, cotton and many other tradables.¹¹

O'Rourke and Williamson go on to apportion these price shocks between Britain and America, and then calculate the impact of these price shocks on the two economies using small-scale CGE models. The simulations indicate that commodity market integration had a big impact on Anglo-American factor prices. Between 1870 and 1913, British real wages increased by 43.1% (Table 1). Heckscher-Ohlin forces accounted for 47% of this increase, or 20.3 percentage points. By contrast, commodity market integration only increased US real wages by 0.3%. The net impact was that commodity market integration had a large impact on the Anglo-American wage gap. As Table 2 shows, commodity price convergence on its own would have reduced the Anglo-American wage gap by 40%, from 71.2% in 1870 to 42.7% in 1910. In fact, while the wage gap declined between 1870 and 1895, it increased slightly between 1870 and 1910 (to 77.6%), confirming the view that the effects of superior American industrial performance were dominant after 1895. Commodity price convergence was playing a significant role in fostering real wage convergence up to 1895 -- just as Heckscher and Ohlin predicted -- and in muting the powerful

¹⁰ Between 1870 and 1910, the wage-rental ratio increased by 173% in Britain, 207% in Denmark, 458% in Ireland, 163% in Sweden, 104% in France, and 42% in Germany. It fell by 34% in Spain, 81% in Argentina, 74% in Australia, and 50% in the United States [O'Rourke, Taylor and Williamson (1996), Table 2].

¹¹ O'Rourke and Williamson (1994), Table 2.

divergence forces set in motion thereafter by Edwardian industrial failure in Britain and Chandlerian industrial success in America.

Next, focus on what was happening to rents in both countries. Between 1870 and 1913, real rents rose by 258.3% in the US, and fell by 55% in Britain (Table 1). CGE exercises suggest that commodity market integration on its own led British rents to fall by 52.3%, and led US rents to increase by 12.1%: commodity market integration thus explains 95% of the decline in British rents, but only 5% of the increase in US rents.

Finally, what was happening to the wage-rental ratio in both countries? In Britain the wage-rental ratio increased by 217.7% between 1870 and 1913, while in the US the ratio fell by 59% (Table 1). Commodity market integration on its own increased the British wage-rental ratio by 152.3%, and lowered the US wage-rental ratio by 10.6%: commodity market integration can thus explain 70% of the increase in the British wage-rental ratio, and 18% of the fall in the US ratio. Taken together, commodity market integration explains 27% of the increase in the British ratio relative to the US ratio.

For the Anglo-American case, at least, Heckscher and Ohlin were spectacularly right: commodity market integration explains a very large share of overall factor price trends during this period. This is particularly true for Britain, which was smaller and more exposed to trade than the US during this period.

To what extent can this finding be generalised? Building CGE models and documenting bilateral commodity price gaps between pairs of countries is a time-consuming business, but O'Rourke and Williamson (1995) have completed the task for one other country, Sweden, which enjoyed a spectacular catch-up performance during the late 19th century. For example, in 1870, real urban unskilled wages in Sweden were only 52% as high as in Britain, and 30% as high as in the USA. By 1910, Swedish real wages were 5% higher than British real wages, and 59% as high as US real wages.¹² Moreover, Scandinavian commodity markets became increasingly integrated with the world economy during this period: exports of Swedish pulp and iron products, Danish agricultural products, Norwegian shipping services, and other goods expanded dramatically. How much of the impressive Anglo-Swedish and American-Swedish convergence can be explained by Heckscher-Ohlin forces?

Since Anglo-American tradable prices converged, O'Rourke and Williamson (1995, pp. 184-188) need only document the evolution of Anglo-Swedish price gaps to say something about both Anglo-Swedish and American-Swedish factor price convergence. Anglo-Swedish price gaps for vegetable products (barley, oats, wheat, potatoes), animal products (beef, pork and butter), and forestry products (hewn timber) all fell significantly between 1870 and 1910. In contrast, the price gap between Britain and Sweden in the home-market-oriented industries (wheat flour, cotton yarn) fell only modestly,

¹² Williamson (1995), Table 2.1, pp. 178-180, and erratum thereto. The figures in the text refer to three-year averages centered on 1870 and 1910. The raw data are provided in Table 3.

while there was no price convergence in Sweden's export industries (copper, sawn lumber, pig iron and iron bars).

What impact did this Swedish commodity market integration into the global economy have on catch-up? A CGE model estimates that Anglo-Swedish price convergence served to raise urban wages in Sweden only by 1.9 percent above what would have been true in its absence [O'Rourke and Williamson (1995), Appendix Table 2.4]. Table 3 tells us how small a contribution commodity price convergence made to the decline in the Anglo-Swedish wage gap, not even 4 percent.¹³

Commodity price convergence across the North Sea, between Britain and Sweden, does not appear to account for a great deal of Anglo-Swedish real wage convergence. Would it not be reasonable to expect that trans-Atlantic commodity price convergence, between Sweden and the New World, should have had a greater impact? In fact it did, but not by much. For example, Anglo-Swedish commodity price convergence increased Swedish agricultural prices, relative to British prices; but trans-Atlantic market integration lowered British agricultural prices. The net impact was only a modest rise in Swedish agricultural prices. Commodity price convergence between the US and Sweden increased Swedish real wages by 6.2%, and raised US real wages by 0.3%, accounting for a little over one-tenth of the Swedish catch-up on the US (Table 3).¹⁴

¹³ This result appears to depend to some extent on the strange behaviour of the export industry price gap. However, it is confirmed by the econometric assessment of trends in the wage-rental ratio in the Atlantic economy reported later.

¹⁴ It must be emphasized that these estimates are based on fragile evidence, particularly where timber prices are concerned. For this reason the US-Swedish Heckscher-Ohlin results should be treated with caution.

Of course, it could be argued that using CGE models to assess the impact of commodity market integration prejudices lots of important issues. In particular, the models used are standard neo-classical trade models, whereas the backwash theorists emphasise very different types of mechanisms. There are three responses to this objection. The minimalist response is to acknowledge the criticism, but point out that (1) late 19th century factor prices moved the way traditional theory predicts; and (2) very traditional static trade models can account for a large proportion of this factor price convergence, at least in the Anglo-American case. A stronger response is that the available evidence shows that, in fact, traditional trade models offer the best description of late 19th century trade patterns which we have. For example, Wright (1990) finds that endowments explain US trade patterns well between 1879 and 1940, a finding supported by Nelson and Wright (1992). Even more convincing support of this proposition is provided by Estevadeordal (1993), who finds that the trade patterns of 18 countries in 1913 is well explained by the Heckscher-Ohlin model. Thus it is reasonable to use traditional trade models to evaluate the impact of globalisation.

A final response is to offer econometric evidence, and this is provided by O'Rourke, Taylor and Williamson (1996). They estimate a model of the form:

$$\text{WGRENT}_{it} = b_{0i} + b_1 \text{LANDLAB}_{it} + b_2 \text{CAPLAB}_{it} + b_{3i} \text{PAPM}_{it} + b_4 \text{PROD}_{it} \quad (3)$$

where for each country i , in period t , the variables in natural logarithms are defined as:

$WRENT_{it}$ = log of the wage-rental ratio;
 $LANDLAB_{it}$ = log of the land-labor ratio;
 $CAPLAB_{it}$ = log of the capital-labor ratio;
 $PAPM_{it}$ = log of the terms of trade (agricultural goods price divided by manufacturing goods price);
 $PROD_{it}$ = a Solovian residual (log of output per worker minus 0.4 times $CAPLAB$ minus 0.1 times $LANDLAB$).

The Ricardo-Viner (specific factors) model¹⁵ suggests that increases in land and capital endowments increase wages and reduce rents, while increases in labour endowments lower wages and increase rents: both β_1 and β_2 should be positive. Heckscher-Ohlin logic suggests that β_3 should be negative.¹⁶ In addition, $PROD$, a Solovian residual, is introduced as a proxy for productivity-enhancing technological forces. If the forces were land-saving (as seems likely in the land-scarce Old World), then we expect $\beta_4 > 0$; if, instead, the forces were labor-saving (as seems likely in the labor-scarce New World), then $\beta_4 < 0$.

Table 4 presents the econometric evidence, where the

¹⁵ Or more generally the three factor two good model.

¹⁶ Henry Thompson (1985, 1986) has however shown that commodity price changes can have counter-intuitive effects on factor prices in a 3x2 setting: an increased price of food could actually lower rents, rather than increase them.

panel data is drawn from a sample of seven countries using five-year period averages from 1870 to 1914. In all cases the $PAPM$ variable is allowed to interact with a country dummy since F-tests of restrictions indicate that the $PAPM$ coefficients vary significantly across countries. An F-test clearly indicates that the New World and the Old World have different structures, and thus should be treated separately, as in columns 2 and 3. The results are quite good: of the 23 estimated coefficients, 19 have the correct sign; most of the 19 pass conventional significance tests; and those with the wrong sign ($PAPM$ coefficients for Australia and Denmark) are not even weakly significant. The results support the insights of traditional trade theory. Capital-deepening and land-deepening both raise the wage-rental ratio, although the impact is larger in the New World (where agriculture was bigger) than in the Old (where agriculture was smaller). A rise in the relative price of agricultural goods favours returns to land over returns to labor, confirming the Heckscher-Ohlin intuition.¹⁷ Economy-wide productivity growth plays a significant role, and one that conforms to qualitative economic histories: that is, while productivity growth was land-saving in the full sample (+0.71, column 1), it was labor-saving in the New World (-0.85, column 2) and land-saving in the Old World (+1.05, column 3), a finding consistent with the induced-innovation hypothesis.

Table 5 examines the quantitative significance of the

¹⁷ Note, however, the results for Australia and Denmark, where a rise in the relative price of agricultural goods favours labor.

Stolper-Samuelson effects, by decomposing the actual changes in wage-rental ratios in the seven countries, showing what proportion of those changes can be explained by changes in the exogenous variables. The analysis confirms that while Heckscher-Ohlin forces may have been significant in the Anglo-American case, they were unlikely to have been as important on the European continent, where protection muted the impact of falling international transport costs. Almost two thirds (Panel A: 61.3%) of the fall in the American wage-rental ratio is explained by PAPM, while PAMM accounts for about one third of the rise in the British ratio (Panel A: 36.9%). Combining the two, we find that about half of the Anglo-American convergence in the wage-rental ratio is explained by commodity-price convergence (Panel B: 48.1%). By contrast, PAMM accounts for only a small proportion of Continental wage-rental trends, and in some cases works in the wrong direction. (In protectionist France, Germany and Sweden, PAMM rises rather than falls.)

Commodity market integration *did* contribute to Anglo-American factor price convergence, but to explain late 19th century convergence more generally, we need to turn to international factor flows, and especially migration.

Section 5. The late 19th century: international factor flows and convergence

Migration

To what extent did the mass migrations of the late 19th

century contribute to convergence? Emigration was particularly important in Ireland, Britain, Scandinavia and Italy, while the New World saw substantial immigration. Tables 2 and 3 indicate that migration mattered a lot for British and Swedish catch-up on America. CGE exercises suggest that on its own, mass migration would have reduced the US-Swedish wage gap from 229% to 149%, accounting for one half of the total Swedish catch-up. On its own, mass migration would have halved the Anglo-American wage gap, reducing it from 71% to 36%. Since both Sweden and Britain experienced high levels of emigration, migration did not greatly reduce the Anglo-Swedish wage gap; still, it does explain 10% of Swedish catch-up on Britain.

What of Ireland, another major contributor to trans-Atlantic emigration? Pre-Famine living standards were stagnant, at least for the poor; but after the Famine, there was a dramatic turnaround in real wages, and Ireland began to converge on the economic leaders of the day.¹⁸ Ó Gráda (1994) concludes that Irish national income per head rose from 40% to 57% of the British level between 1845 and World War 1, and the same picture emerges from the wage data. According to Boyer et al. (1994), between 1860 and 1913 the unskilled building wage rose from 58% to 72% of the British level, while agricultural wages rose from 61% to 75% of the British level.

What makes this Southern Irish catch-up experience unique is that it was achieved despite a decline in manufacturing's share of total employment from 29% to 23% over the period.

¹⁸ The following discussion draws on O'Rourke (1995).

The question thus arises: to what extent was Irish convergence due to emigration? Did the growth in real wages reflect movement up the labour demand curve, rather than an outward shift in the demand curve?

Boyer et al. (1994) attempt to answer this question, using a small-scale CGE model of the Irish economy calibrated to 1907-8 data. They estimate that if there had been no emigration between 1851 and 1911, the real urban wage would only have been 66-81% of its actual 1908 level, while per capita income would have been 75-87% of its actual level: there would have been no Irish catch-up on Britain.¹⁹ Econometric exercises also find a strong link between emigration and improvements in living standards.

Emigration made a crucial contribution to Irish and Swedish convergence on Britain and the US. To what extent can these findings be generalised? Taylor and Williamson (1994) examine the effects of migration on wages in 17 countries in the context of a simple, econometric, partial equilibrium model. In a revision to their original paper, they find that migration can explain all of the convergence experienced between 1870 and 1913 in their 17 countries; allowing for endogenous capital flow responses, migration can account for 69% of the convergence, still an extremely large number.

¹⁹ Unfortunately, the results are sensitive to what assumptions are made about international capital mobility. In particular, if capital inflows were a realistic possibility, then a higher population and lower wages would have attracted such inflows, moderating the reduction in wages. If capital is assumed to be mobile, then in the absence of emigration the urban wage would have been 89-94% of its actual 1908 level, and per capita income 91-95% of its actual level. There would still have been scope for some convergence, although the relative growth in the Irish wage could have been cut by as much as half.

International capital flows

In the late 19th century, international capital flows were predominantly from labour-abundant Europe to the labour-scarce New World. This of course occurred because of the existence of a third factor, land, that was so abundant in the New World that both labour and capital flowed to it. To this extent, international capital flows were a force for overall divergence, at least as far as the current OECD countries are concerned. For example, Table 2 shows that international capital flows on their own would have increased the Anglo-American wage gap, from 71% to 85%.

However, international capital flows helped some countries on the European periphery to catch-up. For example, international capital flows served to increase the Swedish capital stock by 50%, raising Swedish urban wages by 25% over what they would have been in its absence.²⁰ As Table 3 shows, international capital flows can explain over 50% of Sweden's catch-up on Britain, and over 40% of Sweden's catch-up on the US: impressive numbers indeed. Capital importers on the periphery would clearly have suffered had these capital flows been withdrawn; and indeed, Taylor (1992) argues convincingly that the inter-war breakdown of global capital markets explains a large proportion of Argentina's decline after the Belle Époque.

Conclusion

Commodity, and especially factor market integration were

²⁰ O'Rourke and Williamson (1995).

powerful forces implying convergence in the late 19th century. Ireland could not have converged on Britain and the US in the absence of emigration; Sweden could not have converged on Britain and the US in the absence of emigration and capital inflows. Taylor and Williamson's (1994, revised) partial equilibrium estimates suggest that over two thirds of the convergence that characterised the OECD club between 1870 and 1913 can be explained by migration, even when endogenous capital-chasing is allowed for. Heckscher-Ohlin effects played a powerful role in Britain, muting the divergence which disparate Anglo-American industrial performances would have otherwise implied. The optimistic conclusions of model-based studies regarding the impact of globalisation on convergence have been reinforced by such econometric exercises as have been performed.

International economic integration in the late 19th century can largely explain the convergence that was experienced during that period. It remains to be seen whether the cessation of convergence in the inter-war period can be attributed to the breakdown of the international economy; and whether post-1945 convergence is due to the effects of GATT and the resumption of international lending.

Section 6. Conclusion

Open economy forces played a crucial role in the convergence experience of the late 19th century; and the available evidence suggests that the link between

globalization and convergence has held through the twentieth century as well. Moreover, international commodity trade served to equalize factor prices between 1870 and 1913, just as Heckscher and Ohlin suggested; although the effect was greater in Britain than elsewhere, and migration was a far more important force for convergence generally. To the extent that these forces continue to operate today, it is likely that European integration will bring convergence, rather than divergence, between the European core and periphery.

However, much work still needs to be done. In particular, we need to understand precisely what the mechanisms are through which openness affects the regional dispersion of incomes: is it commodity trade that matters, or international capital mobility, or direct foreign investment and technology transfer? Related to this point, we need to test for the links between openness and convergence in a more rigorous, model-based way than has been true to date.

The current boomlet of literature linking North-South trade and income inequality in the North [surveyed in Burtless (1995)] leaves many important questions unanswered. For example, many studies [e.g. Borjas, Freeman and Katz (1992), Murphy and Welch (1991), Sachs and Shatz (1994), Wood (1994)] calculate the *factor content* of trade, and estimate how much factor demands would change as a result of exogenous changes in trade flows. The latter two studies are aware of the approach's key failing: in traditional theory, trade is not exogenous, but endogenous, responding to changes in tastes, technology (including transport technology), endowments and

policy. If increased trade is due to technological change, then the resultant changes in factor demands should be attributed to domestic rather than international forces. For a small open economy, the key conduit for international forces is commodity prices, a point accepted by all of the trade economists involved in this debate, but emphasised most strongly by Lawrence and Slaughter (1993) and Leamer (1994, 1995).

Other studies, such as Revenga (1992) examine the impact of import prices on wages, but on an industry-by-industry basis. Again, this does not amount to a test of the Stolper-Samuelson framework, since that theorem predicts that trade impacts skill differentials equally in all sectors, traded and non-traded.

What we need to resolve these issues is first, more cross-country evidence on inequality, such as that provided by Davis (1992) and Wood (1994), both of whom find that inequality has increased in the North and declined in the South in the 1980s. Second, we need this evidence over a long period, not just after 1945. If open economy forces are important in driving skill differentials, then we should see skill differential convergence before 1913 and after 1945, but not in the interwar period. And third, we need to relate this cross-country evidence to variables that are clearly exogenous: traded commodity prices, factor endowments, and technological change.

The evidence to date suggests strongly that the European periphery will benefit from European integration. But a lot

of work needs to be done to confirm the hunch that trade in the late 20th century still has the impact on factor prices, and hence on convergence, that Heckscher and Ohlin predicted.

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Table 1
The Estimated Impact of Anglo-American Commodity price convergence on factor prices, 1870-1913
 (percentages)

Variable	Actual Movement in Factor Prices		Estimated Impact	
	United States	Great Britain	United States	Great Britain
Early Period: 1870-1895				
Nominal returns				
Urban wage	-16.0	+17.1	+5.7	+7.1
Land rent	+19.9	-46.1	+10.1	-31.0
Return to capital	n.a. ^a	n.a.	+2.6	+6.5
Wage-rental ratio	-29.9	+117.3	-3.9	+55.2
R		+210.0		+61.6
Real returns				
CPI	-35.7	-25.0	+5.7	-2.1
Real urban wage	+30.6	+56.1	+0.1	+9.4
Real land rent	+86.5	-28.1	+4.2	-29.6
Real return to capital	n.a.	n.a.	-2.9	+8.8
Full Period: 1870-1913				
Nominal returns				
Urban wage	+11.4	+32.5	+13.3	+11.7
Land rent	+171.6	-58.3	+26.7	-55.7
Return to capital	n.a.	n.a.	+3.6	+10.8
Wage-rental ratio	-59.0	+217.7	-10.6	+152.3
R		+674.9		+182.2
Real returns				
CPI	-24.2	-7.4	+13.0	-7.1
Real urban wage	+47.0	+43.1	+0.3	+20.3
Real land rent	+258.3	-55.0	+12.1	-52.3
real return to capital	n.a.	n.a.	-8.4	+19.3

^a n.a. = data not available

Note: R is the percentage increase in the British relative to the U.S. wage-rental ratio

Source: Erratum to O'Rourke and Williamson (1994), forthcoming, *Journal of Economic History*.

Table 2
Open Economy Forces and Anglo-American Catch-Up 1870-1910

Source	1870	1910	1910 - 1870
Anglo-American Wage Gap			
Actual	71.2%	77.6%	+6.4%
Due to:			
[1] Mass migration	71.2	36.4	-34.8
[2] Foreign capital flows	71.2	84.9	+13.7
Labor and capital flows combined (= [1]+[2])	71.2	47.2	-24.0
[3] Commodity market integration (price convergence)	71.2	42.7	-28.5
Total open economy convergence forces	71.2	22.8	-48.4
[4] Residual	71.2	126.0	+54.8

Source: Table 1. Actual is calculated as 3-year averages centered on 1870 and 1910, from Williamson (1995, Table A2.1) and erratum thereto. Wage gaps are calculated as the percent by which US wages exceeded British wages. The raw data are given in a note to Table 3 below.

Table 3
Open Economy Forces and Scandinavian Catch-Up 1870-1910

Source	1870	1910	1910 - 1870
Anglo-Swedish Wage Gap			
Actual	92.3%	-4.4%	-96.7% (100.0)
Due to:			
[1] Mass migration	92.3	82.5	-9.8 (10.1)
[2] Foreign capital flows	92.3	42.3	-50.0 (51.7)
Labor and capital flows combined (= [1]+[2])	92.3	35.1	-57.2 (59.2)
[3] Commodity market integration (price convergence)	92.3	88.7	-3.6 (3.7)
Total open economy convergence forces	92.3	32.6	-59.7 (61.7)
[4] Residual	92.3	55.3	-37.0 (38.3)
American-Swedish Wage Gap			
Actual	229.2	69.9	-159.3 (100.0)
Due to:			
[1] Mass migration	229.2	148.8	-80.4 (50.5)
[2] Foreign capital flows	229.2	163.2	-66.0 (41.4)
Labor and capital flows combined (= [1]+[2])	229.2	99.0	-130.2 (81.7)
[3] Commodity market integration (price convergence)	229.2	210.9	-18.3 (11.5)
Total open economy convergence forces	229.2	87.9	-141.3 (88.7)
[4] Residual	229.2	211.2	-18.0 (11.3)

Source: O'Rourke and Williamson (1995), Table 1.

Notes: Actual is calculated as 3-year averages centered on 1870 and 1910, from Williamson (1995, Table A2.1) and erratum thereto. Wage gaps are calculated as the percent by which the countries exceeded Sweden. Thus, for 1870, the Anglo-Swedish gap was $(66.00-34.33)/34.33 = 0.9225$ or 92.3%. The underlying wage data are:

	Sweden	USA	Britain		Sweden	USA	Britain
1869	42	107	66	1909	96	172	97
1870	28	115	67	1910	100	170	95
1871	33	117	65	1911	103	166	94
Ave	34.33	113.00	66.00	Ave	99.67	169.33	95.33

Table 4
The Determinants of the Wage-Rental Ratio in the Old and New Worlds
1875-1914

Regression sample	(1) ALL	(2) NEWWORLD	(3) OLDWORLD
LANDLAB	1.09** (6.88)	1.16** (11.39)	0.77** (3.53)
CAPLAB	1.26** (5.37)	1.19** (3.43)	0.83 (3.17)
PROD	0.71 (3.66)	-0.85* (3.60)	1.05 (8.79)
AUSxPAPM	0.76 (1.20)	0.58 (1.21)	----
USAxPAPM	-6.09** (10.66)	-1.94 (2.08)	----
FRAxPAPM	-4.78** (7.17)	----	-4.74** (8.79)
GERxPAPM	-0.93 (1.82)	----	-0.91 (1.76)
GBRxPAPM	-1.64** (3.68)	----	-1.26** (3.28)
DENxPAPM	1.19 (0.92)	----	0.14 (0.14)
SWExPAPM	-0.45 (1.42)	----	-0.63* (2.15)
R ²	0.834	0.936	0.879
Standard error of estimate	0.12	0.10	0.10
Number of observation	56	16	40
Degrees of freedom	39	9	27
Durbin-Watson	2.10	2.60	1.83
Restrictions	p=0.00**	p=0.02**	p=0.00**
Cointegration tests:			
Durbin-Watson	p<0.01**	p<0.01**	p<0.01**
Dickey-Fuller (0 lags): Z _{DF}	-51.43**	-19.02**	-38.07**
Phillips-Perron (4 lags): Z _{PP}	-43.45**	-14.74**	-34.43**
Bayes: t ²	56.19	24.27	51.27
F-test, {column 1} vs. {columns 2,3}: F(3,36)=7.91, p=0.00			

** significant in one-tailed test at 1% level; * at 5% level
Notes: dependent variable is WGRENT. Estimation: panel OLS with fixed effects (variables have country mean removed prior to regression). Absolute t-statistics in parentheses. Restrictions is the test that the PAPM coefficients are equal across countries. Durbin-Watson cointegration test follows Sargan-Bhargava testing for DW=0. Dickey-Fuller and Phillips-Perron test for unit root in the residuals and include a constant term but no trend. All regressions and tests are implemented using the RATS econometrics software. NEWWORLD = (AUS,USA); OLDWORLD = (FRA,GER,GBR,DEN,SWE).

Source: O'Rourke, Taylor and Williamson (1996), Table 3.

Table 5

Decomposition of Changing Wage-Rental Ratios, 1875-1914

A: explaining changes (log change per decade)						
	change in WGRENT	due to LANDLAB	due to CAPLAB	due to PAPM	due to PROD	residual
AUS shares	-0.255 100.0%	-0.148 58.2%	-0.042 -16.4%	-0.015 6.0%	-0.041 16.1%	-0.008 3.3%
USA shares	-0.188 100.0%	-0.081 43.0%	0.154 -82.2%	-0.115 61.3%	-0.132 70.4%	-0.014 7.5%
FRA shares	0.105 100.0%	-0.076 -72.9%	0.062 58.9%	-0.027 -26.3%	0.055 52.2%	0.092 88.1%
GER shares	0.064 100.0%	-0.103 -161.4%	0.132 207.0%	-0.022 -34.7%	0.069 108.5%	-0.012 -19.3%
GBR shares	0.220 100.0%	-0.082 -37.2%	0.060 27.0%	0.081 36.9%	0.094 42.7%	0.067 30.5%
DEN shares	0.248 100.0%	-0.020 -8.1%	0.066 26.8%	0.002 0.8%	0.218 88.1%	-0.019 -7.6%
SWE shares	0.231 100.0%	-0.009 -3.9%	0.104 45.2%	-0.032 -13.6%	0.174 75.5%	-0.007 -3.2%
NEWORLD (avg.) shares	-0.221 100.0%	-0.115 51.8%	0.056 -25.5%	-0.065 29.5%	-0.087 39.1%	-0.011 5.1%
OLDWORLD (avg.) shares	0.324 100.0%	-0.128 -39.6%	0.126 38.8%	0.074 22.8%	0.164 50.6%	0.089 27.5%

B: explaining convergence (log change per decade)

	change in WGRENT	due to LANDLAB	due to CAPLAB	due to PAPM	due to PROD	residual
NEWORLD minus OLDWORLD shares	-0.545 100.0%	0.014 -2.6%	-0.069 12.7%	-0.139 25.5%	-0.250 45.9%	-0.100 18.4%
US minus GB shares	-0.408 100.0%	0.001 -0.3%	0.095 -23.2%	-0.196 48.1%	-0.226 55.4%	-0.081 20.0%

Source: O'Rourke, Taylor and Williamson (1996), Table 4. The decomposition analysis simply multiplies the changes in the right-hand side variables by the regression coefficients in Table 4.

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