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OPEN ECONOMY FORCES AND LATE 19TH CENTURY SCANDINAVIAN CATCH-UP

Kevin O'Rourke
Jeffrey G. Williamson

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ABSTRACT

Scandinavia recorded very high growth rates between 1870 and 1914, catching up with the leaders. This paper estimates that about two-thirds of the Scandinavian catching up on Britain was due to the open economy forces of global factor and commodity market integration. All of the Scandinavian catching up on America was due to the same open economy forces. The question for the economist is: Why does the new growth theory spend so little time dealing with these open economy forces? The question for the economic historian is: Can the breakdown of global factor and commodity markets after 1914 explain a large share of the cessation of convergence up to 1950? Can the spectacular OECD convergence achieved after 1950 be explained by the resumption of the pre-1914 open economy conditions that contributed so much to Scandinavian catch-up?

Kevin O'Rourke
Department of Economics
University College Dublin
Belfield, Dublin 4
IRELAND

Jeffrey G. Williamson
Department of Economics
Harvard University
Cambridge, MA 02138
and NBER

1. THE ISSUES

Among the current members of the OECD club at least, the late 19th century was a period of convergence. Poor countries at the periphery of the European OECD club tended to grow faster than rich countries at the center of the Old World or even those overseas in the New World. This club excluded, of course, the Third World and eastern Europe, and even around this limited periphery there were some who failed to catch-up. But while Spain and Portugal lagged behind the leaders, from the Great Famine to the Great War, Ireland, Italy and the Scandinavian countries underwent a spectacular catch-up. The performance of the Scandinavian countries was particularly impressive: per capita income, real wages and average labor productivity grew faster in Denmark, Norway, Sweden and even Finland than in the rest of northwestern Europe. Thus, the gap between the Scandinavian late-comers and Britain narrowed considerably over the half century. To offer just two examples: between 1870 and 1910, Swedish labor productivity rose from 39 to 53 percent of Britain; over the same forty years, Danish unskilled urban real wages rose from 52 to 96 percent of Britain. Indeed, real wages in Scandinavia even rose relative to fast-growing America: Norwegian urban unskilled real wages rose from 25 to 43 percent of the USA, while those in Sweden rose from 30 to 59 percent of the USA (Williamson, 1995, Table A2.1, p. 39, 3 year averages centered on 1870 and 1910).

This rapid Scandinavian catch-up is now well documented, but it was apparent to Swedish economists writing in the midst or at the end of the period -- like Knut Wicksell, Eli Heckscher and Bertil Ohlin. The amazing aspect of the literature on the famous Scandinavian catch-up is that no one, to our knowledge, has tried to assess its sources. There is no shortage of assertion, of course, ranging from schooling advantages, favorable price shocks, the right natural resource endowment, trade creation, mass emigration and elastic foreign capital inflows. Assertion is one thing, however; empirical assessment guided by explicit economic argument is another.

This paper offers that empirical assessment, although we must confess that it has more to say about Sweden than about the rest of Scandinavia. The next section documents the impressive Scandinavian performance and

places it within the larger catching up phenomenon observed for the late 19th century OECD club. The section spends most of its time comparing Angus Maddison's GDP per worker figures with Jeffrey Williamson's real wage figures. Both document relatively high growth rates in Scandinavia. However, even when unconditional catch-up is estimated for sixteen countries, Scandinavia still appears to be an outlier, even growing faster than the estimated unconditional convergence model would have predicted. That is, Scandinavia was an overachiever even by the standards of catching up in the late 19th century. Section 3 asks whether this unusual rate of catch-up can be explained by unusual levels of schooling, as recently asserted by Lars Sandberg, Richard Easterlin and the new growth theorists. The answer is "yes", but not much. Section 4 responds to Knut Wicksell's challenge and measures the contribution of mass emigration to the catch-up. Section 5 explores the Solovian core of the new growth theory, capital deepening, and something which economic historians have long stressed for Sweden: foreign capital inflows financed a very large share of the expensive social overhead always associated with early industrialization. Section 6 adds the important assertions of two more Swedes, Eli Heckscher and Bertil Ohlin. Heckscher and Ohlin argued that trade created by commodity price convergence might have accounted for a large portion of the observed catch-up, an argument which evolved into the famous (and often misunderstood, even by the smartest economists) factor price equalization theorem. The theorem has never been tested on the Scandinavian experience which motivated the brilliant Heckscher and Ohlin insight in the first place. So, to what extent was trade a substitute for international factor mobility in accounting for Scandinavian factor price, productivity and living standards convergence on the leaders?

All of the factors listed so far have their source in open economy influences, or, to use the modern vernacular, in late 19th century globalization. Section 7 discusses additional trade issues that have always played an important role in Norwegian and Swedish histories. Did global price shocks -- independent of Heckscher-Ohlin commodity price convergence -- favor Scandinavian resource-intensive export sectors? If these were trade-creating favorable price shocks (associated with booming British

export demand), they should be separated from the trade-creating commodity price convergence forces since the former has to do with the consequences of good luck specific to Scandinavia while the latter has to do with the impact of systematic global commodity market integration generic to convergence induced in this case by a spectacular decline in global transport costs. Section 7 supplies more assertion than evidence since we simply do not yet know enough about the Scandinavian export sector.

Section 8 pulls all the parts together to offer one bottom line: How much of the Scandinavian catch-up was due to open economy forces, forces which have been all but ignored by the new growth theory?

2. LATE 19th CENTURY SCANDINAVIAN CATCH-UP

This section exploits four independent sources of evidence in an effort to gauge Scandinavian late 19th century catch-up. The first contains purchasing-power-parity adjusted real wages for the urban unskilled in sixteen countries (Williamson, 1995): four New World countries -- Argentina, Australia, Canada, USA; and twelve Old World countries (including three from Scandinavia) -- Belgium, Denmark, France, Germany, Great Britain, Ireland, Italy, the Netherlands, Norway, Portugal, Spain and Sweden. The second documents trends in the wage-rental ratio, the ratio of unskilled urban wages to farm land values for ten of the Williamson sample (O'Rourke, Taylor and Williamson, 1993: excludes Belgium, Canada, Norway, the Netherlands, Italy and Portugal). The third contains some older constant price GNP per capita estimates which overlaps with the Williamson European sample except for the exclusion of Ireland and Portugal (Bairoch, 1976). Finally, the fourth contains modern GDP per worker-hour estimates which has a more limited overlap with the Williamson sample (Maddison, 1991: excludes Argentina, Spain, Portugal and Ireland, but includes Austria, Finland and Switzerland).

Apart from the fact that these data were constructed from different sources and by different scholars, they are unlikely to tell exactly the same convergence story. Per capita and per worker-hour convergence may differ according to trends in labor participation rates and length of the

working day. If the forces of demographic transition are strongest for the richer countries (higher fertility and lower infant mortality) -- causing population growth to exceed labor force growth, and if these forces are reinforced by a legislated shortening in the length of the work week first in labor-scarce rich countries (who could best afford it), then it follows that per capita convergence will be faster than per worker-hour convergence. If the forces of international migration dominate instead, then the opposite would be true since migrants are mainly young adults. Second, GDP per worker-hour is, after all, nothing more than average labor productivity, and convergence of it and real wages may differ for various reasons. The real wage deflator may behave differently than the GDP deflator, an event which was especially true of the late 19th century when the price of foodstuffs fell sharply in the labor-abundant Old World, which imported these key wage goods, relative to the labor-scarce New World, which exported them. Thus, real wage convergence should have been more dramatic than GDP per-worker convergence on that score alone. This prediction is reinforced to the extent that marginal labor productivity (e.g., the real wage) rose faster than average labor productivity (e.g., GDP per worker-hour) in land scarce, labor abundant poor countries than in land abundant, labor scarce rich countries. After all, farm land prices and rents collapsed in poor late 19th century Europe while they surged in the rich New World. It follows from this argument, third, that wage-rental ratio convergence should have been even more dramatic than real wage convergence because both wages and farm rents converge but in opposite directions, thus making wage-rental convergence faster than wages alone and certainly faster than some aggregate GDP measure which, among other things, aggregates up across rents and wages. As we shall see in a moment, the late 19th century annual growth rates implied by all four indicators seem to accord well with these predictions.

Consistent with qualitative accounts (Heckscher, 1954; Jorberg, 1970; Lieberman, 1970; Hildebrand, 1978; Persson, 1993) and the pioneering comparative national product estimates of Olle Krantz and Carl-Axle Nilsson (1974), the evidence in Table 1 confirms that Sweden and Denmark tended to outperform Norway and Finland, but only Paul Bairoch's data (column 3) show

a wide spread in the performance between the Scandinavian four. While Bairoch's GNP per capita figures show Sweden growing at twice the rate of Finland and almost twice the rate of Norway, Maddison's GDP per worker-hour figures (column 4) reveal only modest differences between them. The same is true of Williamson's real wage data (column 1), which show Sweden growing only a little faster than the Scandinavian average (2.70 versus 2.58 percent per annum). In short, recent evidence suggests that rapid catching up was common to all four Scandinavian countries.

The Scandinavian catch-up is certainly confirmed by the evidence in Table 1. Real wages grew at rates almost three times those prevailing elsewhere in Europe; Swedish workers enjoyed real wage growth rates two and a half times that of British workers; and Danish workers enjoyed real wage growth rates two and a half times that of German workers. In fact, there was no country elsewhere in our European sample that underwent real wage growth even close to that of Sweden or Denmark. What was true for real wages was also true for the wage-rental ratio. While the ratio of wage rates per worker to farm land values per acre fell everywhere in the New World, it rose everywhere in Europe (with the exception of Spain). These events reflect the invasion of grains from the New World (and Russia) which lowered farm rents and land values in Europe and raised them in the American Midwest, the Argentine pampas and elsewhere in New World granaries. While the Scandinavian wage-rental ratio seems to have tracked the British ratio very closely (2.45 versus 2.54 percent per annum growth), the ratio rose half again faster in Scandinavia than elsewhere in Europe. Once again, factor prices converged more dramatically in Scandinavia. Bairoch's per capita income figures document Scandinavian growth rates almost two times those in the rest of Europe. Consistent with our predictions, Maddison's product per worker-hour estimates document a less spectacular Scandinavian catch-up, but even his data confirm a relatively impressive growth performance among the Nordic countries.

Scandinavia outperformed the rest of the OECD club (and probably the rest of the world) in the late 19th century, of that there is no doubt. However, we have come to expect this kind of performance: as long as they are members of the "club", poor countries tend to grow faster than rich

countries, the economic differences between them tend to erode with time, and economic convergence takes place. There are two prominent explanations offered for such convergence, although we intend to pursue other possibilities in this paper. The first appeals to Nobel-laureate Robert Solow and his Solovian forces of accumulation and capital deepening. Capital is scarce in poor countries, so accumulation rates should be fast there, while capital is abundant in rich countries, so accumulation should be slow there. Labor is abundant in poor countries so population and labor force growth should be slow there -- due to late marriage, low fertility within marriage and high infant mortality, while the opposite should be true of labor scarce rich countries. Capital-deepening should, therefore, favor poor countries. Mass migrations and well-functioning world capital markets should help this process along: mass migration from poor countries to rich countries and capital export from rich countries to poor countries should help contribute to catching up. The second appeals to Alexander Gerschenkron (1952) and the forces of technology diffusion: in the poorest countries, the productivity gap between best technological practice prevailing among the industrial leaders abroad and the traditional technological practice prevailing at home is enormous; thus, a catch-up growth potential among the poorest is also enormous. Convergence is assured (if "social capability" conditions are satisfied: Abramovitz, 1986). What determines membership in the convergence club is, of course, another matter entirely.[1]

Although economic historians had been talking about it for years, convergence in the OECD club was documented with hard evidence only fairly recently (Abramovitz 1986; Baumol 1986; Baumol et al., 1989, Chp. 5; Prados, Sanchez and Oliva, 1993). Typically, these studies rely solely on

[1]To repeat, this paper will focus on the sources of Scandinavian catch up in the late 19th century, hoping to get further insight into the forces driving convergence within the OECD club. We have nothing to say about what determines membership. However, we are well aware that European convergence may have been limited to the club. Indeed, while Table 2 offers some weak evidence of GNP per capita convergence using Bairoch's data on the OECD club, there is no evidence of convergence when the Bairoch's full sample is used (that is, when such central, south and east European countries like Austria-Hungary, Bulgaria, Greece and Russia are added). The point was made with clarity by J. Bradford DeLong (1988) in his debate with William Baumol (1986).

Maddison's aggregate labor productivity estimates, but they have been confirmed recently by real wage experience (Williamson, 1995). Indeed, Williamson's real wage information has added a number of new facts to the debate. First, real wages converged at more rapid rates than did average labor productivity. Second, although real wage convergence during the late 19th century was pronounced, it was less dramatic than it was during the more familiar post World War II decades. Third, secular convergence ceased between 1914 and 1950. This, of course, was also a period of quotas on New World immigration, a collapse in world capital markets, and a surge in commodity protection. Global openness and convergence seem to be positively correlated; global autarky and convergence seem to be negatively correlated. Fourth, much of the late 19th century convergence documented for the OECD club was explained by the erosion in the gap between the labor-scarce, land-abundant New World and the labor-abundant, land-scarce Old World. To restrict the analysis of late 19th century convergence to Europe is to miss the most important catching up event of the period, namely, the Old World catching up on the New.

Scandinavia was central to OECD convergence in the late 19th century, but did it grow as fast as convergence models predict? Or did it grow faster? Figure 1 supplies an answer using real wages, and Table 2 reports the underlying unconditional convergence regressions for real wages as well as for GDP per worker-hour and GDP per capita.[2] The equation estimated is widely used in the convergence literature (Barro 1991; Barro and Sala-i-Martin 1991; Mankiw et al. 1992; Barro and Sala-i-Martin 1992; Prados, Sanchez and Oliva 1993). Thus, in the first row of Table 2 a measure of late 19th century real wage growth (the difference in the logarithms of real wages, 1913 versus 1870) is simply regressed on the logarithm of the real wage in 1870. Each row (and corresponding figure) confirms "unconditional" convergence, although the real wages underlying row 1 converged faster than GDP per worker and GNP per capita, just as theory

[2]The words "conditional" and "unconditional" come from the empirical work of the new growth empiricists like Robert Barro and Xavier Sala-i-Martin (1992), and Gregory Mankiw, David Romer and David Weil (1992). They refer to convergence conditional on, or after controlling for, schooling and other forces excluded from the standard Solow model.

would predict.[3] Furthermore, the rate of convergence (λ) underlying Maddison's GDP per worker-hour data is very close to that estimated recently by Leandro Prados and his collaborators; the λ implied by what we call the OECD club is 0.011 (Table 2, entry 2) while Prados and his collaborators (1993, Table 4, p. 9) report λ ranging between .009 and 0.010 for what they call the pre-World War I European "core" (Belgium, Denmark, France, Germany, the Netherlands, Sweden, Switzerland, and the United Kingdom). In any case, the slope coefficients in these regressions imply a rate of convergence which accords fairly well with post World War II experience: a late 19th century rate of convergence of 1.1 percent per annum (e.g., λ = 0.011) is not so far below the estimates typically found for post World War II, about 2 percent per annum (Mankiw et al., 1992; Barro and Sala-i-Martin, 1992).

Elsewhere we have shown (HIER, Figures 2 through 4) that convergence took place throughout the late 19th century: that is, it proceeded at exactly the same rate between 1850 and 1870 as between 1870 and 1890, falling off a bit only after 1890. However, while Norway and Sweden grew faster than average between 1850 and 1870, they exhibited predictable rates of catch-up. The Scandinavian countries began to deviate on the up side of the convergence path in the 1870s and 1880s, although Sweden was the main overachiever. From the 1890s to World War I, Norway and Denmark joined Sweden as overachievers.

Scandinavia was clearly part of the catch-up process in the late 19th century, and it was a process that started as early as 1850. In fact, Scandinavia, led by Sweden, was an overachiever, growing even faster than an estimated European unconditional catch-up model predicts. While Scandinavian catching up started as early as 1850, the impressive

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[3]The $\hat{\beta}$ underlying Figure 1 is -0.390 (Table 2, entry 1). The rate of convergence is

$$\lambda = \tfrac{1}{t} \ln (\hat{\beta} + 1)$$

where t is the time span (43 years) and $\hat{\beta}$ is the coefficient for the log of initial real wages, income per capita or labor productivity. Actually, we use the term "speed of convergence" too loosely in this context. Speed of convergence technically is λ times the initial gap. If λ =0.01, then it would take 70 years to cut the gaps in half. Thus, had the late nineteenth century rate of convergence persisted, by 1940 gaps would have been half that of 1870. Eliminating big initial gaps takes a long time, even when there is fast convergence at work.

overachievement did not appear until after 1870.

This evidence raises a number of questions: What explains the late 19th century Scandinavian catch-up? What explains Scandinavian overachievement after 1870? Does the appearance of overachievement after 1870 have anything to do with the fact that foreign capital inflows and labor emigration were biggest then, or that commodity price convergence and the trade surge was also biggest then? Were open economy forces doing most of the work driving the spectacular Scandinavian catch-up? This essay seeks to answer all of these questions.

3. ARE SANDBERG AND THE NEW GROWTH THEORISTS RIGHT? SCHOOLING, LITERACY AND CATCH-UP

Given the simplicity of the "unconditional" convergence equations estimated in the previous section, it is a wonder that any of them are statistically significant. Certainly the new growth theorists have been motivated by that fact when deriving "conditional" convergence equations. Thus, the standard conditional convergence equation (e.g., Mankiw et al., 1992, p. 426) includes labor force growth, investment shares in output and schooling. As far as we are aware, only Leandro Prados and his collaborators (Prados, Sanchez and Oliva 1993) have attempted to estimate convergence equations over two centuries conditional on schooling. However, they do not report results for the late 19th century separately, nor do they tell us how much of the Scandinavian catch-up might be assigned to education. It is essential to fill in those blanks since so many historians have asserted that favorable Scandinavian education and literacy levels were absolutely fundamental to its ability to catch-up on the leaders prior to World War I.

In 1979, Lars Sandberg published a wonderfully suggestive paper entitled "The Case of the Impoverished Sophisticate" which explored the relationship between schooling and Swedish economic growth before World War I. Sandberg did not offer an explicit test of his schooling hypothesis at that time, but no one, including the new growth theorists or Richard Easterlin in his 1981 presidential address to the American Economic History

Association, has stated the proposition with greater clarity. While "catching up" was not quite part of the economist's language in 1979, Sandberg was motivated by the speed of Swedish late 19th century growth:

> "It is ... my contention that the speed of Sweden's pre-World War I economic growth and industrialization was to a significant degree a result of the country's disproportionately large initial stock of [human capital] (1979, p. 228)."

The human capital that Sandberg thought mattered most was schooling and literacy. Lennart Jorberg (1969, p. 275; 1970, pp. 386 and 396) and K.-G. Hildebrand (1978, p. 603) said as much in earlier surveys, but they did not develop the argument with the care that Sandberg did. Carlo Cipolla (1969) certainly offers plenty of evidence supporting the impoverished sophisticate view. Cipolla documents (1969, Table 6, p. 72) high literacy levels in Scandinavia compared with the rest of Europe and, based on such evidence, argued that the "more literate countries were the first to import the Industrial Revolution" (p. 87). By 1850, Sweden was the most literate country in Europe and was the only European country that could measure up to the United States in that dimension (Sandberg, 1979, p. 230).[4] Indeed, in a later paper Sandberg used Cipolla's 1850 qualitative data on literacy to show that the 1850 educational ranking was highly correlated with the 1970 per capita income ranking, and that up to 1913 "the poor, high literacy countries ... grew the fastest ... As for the low literacy countries, this group's growth rate was clearly slower than that of the others" (Sandberg, 1982, p. 689). Gabriel Tortella (1994) has recently elaborated on this latter observation to find explanations for economic retardation in the Mediterranean basin, and Clara-Eugenia Nunez (1990) has done the same for regions within Spain.

These important studies fall short of our goal. They look for correlations in the data, rather than assess the contribution of schooling to catching up (or falling behind). These earlier studies do not supply the answer to the question: How much of the Scandinavian catch-up in the late

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[4]Others have pursued this connection between education and economic performance in Sweden since Sandberg's paper appeared, and some are critical of the impoverished sophisticate hypothesis (e.g., Nilsson and Pettersson, 1990, 1992; Markussen, 1990).

19th century can be explained by schooling advantages? Furthermore, none of them attempt to estimate convergence equations conditional on schooling. As we pointed out above, Leandro Prados and his collaborators (Prados, Sanchez and Oliva 1993) have recently done so, but there is reason to do more since they: only perform the tests on the rate of growth of GDP per capita; only include a limited number of OECD club members in their "core" convergence club (excluding all of the New World, for example); do not report results separately for the late 19th century, but rather only for the complete modern era 1820-1990, when there is reason to expect very different convergence dynamics within shorter epochs (Williamson 1995); and (last but surely not least) consistently report poor results on the schooling variable (Prados, Sanchez and Oliva 1993, Tables 14-16, pp. 53-5, "escolar").

The new growth theorists use school enrollment rates as a proxy for average educational achievement in analyzing conditional convergence in the post World War II period. Table 3 offers late 19th century enrollment rates in column (1), typically taken as mid-point averages for the four decades as a whole. If we exclude Finland from the Scandinavian average, the Mediterranean Basin (Italy, Spain and Portugal) from the non-Scandinavian European average and Argentina from the New World average, then impoverished Scandinavia measures up very well with the rest of Europe and even with the far richer New World. Column (2) offers some literacy rate estimates: the European figures are those reported for immigrants by United States authorities in the 1890s (heavily weighted by young adults), while the New World estimates are for adults. Column (3) offers yet another enrollment rate estimate, this one from Leandro Prados and his collaborators. While each of these three measures of schooling is imperfect, they appear to tell roughly the same story.

Sandberg is right: school enrollment (and literacy) rates in Sweden were much higher than Swedes could, in some sense, afford;[5] this high

[5]Markussen (1990, p. 37) has stressed that the Nordic countries were unique in that there was a long lag, perhaps 100-150 years, between development of reading and writing skills. Indeed, while their reading skills and enrollment rates are well above what one would expect for poor countries (Table 3), Markussen (1990, Table 1, p. 53) shows that they were well below in writing skills at least based on per capita letters and

commitment to schooling in this impoverished country must have been driven by non-economic forces. The interesting questions, however, are these three: First, does schooling explain much of late 19th century convergence in the OECD club? Second, does the early Lutheran-driven and peasant-power commitment to education explain much of Scandinavian overachievement? Third, and most important, does schooling explain much of Scandinavian catch-up?

Some answers to the first question -- does schooling account for much of the catch-up in the OECD club? -- appear in Table 4. The enrollment rates in the first panel suggest the following conclusions:[6] the schooling contribution to real wage convergence was statistically significant, but its contribution to GDP per worker growth was statistically insignificant.[7] Note in both cases that the rate of convergence is raised to 1.3 or 1.7 percent per annum when conditioned by schooling, much closer to the late 20th century 2 percent per annum stylized fact. Furthermore, it appears that schooling accounts for most of Scandinavian overachievement in the late 19th century (HIER, Figures 7 and 8).

Finally, what about the third and most important question? That is,

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postcards sent.

[6]The contribution of schooling to convergence is even less significant based on the literacy rate estimates in the second panel of Table 4.

[7]This result is consistent with that reported by Prados, Sanchez and Oliva (1993, Tables 14-16, for GDP per capita).

The new growth theorists typically estimate conditional convergence equations that include labor force growth as well. In fact, the augmented Solow model of conditional convergence (Mankiw, et al., 1992, p. 426) includes initial labor productivity levels, schooling, the rate of labor-augmenting technical change (g), the depreciation rate on physical capital (δ) plus the labor force growth rate (n). When estimated on post World War II evidence, the new growth theorists make the following assumptions: g and δ are exogenous, the same across countries, and their sum is equal to .05; n is exogenous, but takes on its observed country-specific value. It is the assumption about n that blatantly violates late 19th century evidence. Countries with high real wage and labor productivity growth tended to have high labor force growth (Williamson 1995). The fact that income growth raises labor force growth through natural rates of increase and immigration while labor force growth creates (by itself) diminishing returns has always, of course, bedeviled any scholar's attempt to use time series as a test of either proposition. Thus, when log ($n+g+\delta$) is added to the regressions reported in Table 4, the R^2 soars and the t-statistic is large (3.16). However, the coefficient on log ($n+g+\delta$) is **positive** (+1.10), offering no confirmation of Solow's neoclassical growth model, but offering plenty of support for elastic labor supply responses. Thus, we ignore this silly part of the new growth theory in Table 4 and the text.

how much of the above-average late 19th century growth in Scandinavia is due to schooling? Above-average schooling accounted for a fairly impressive 17 percent of above-average real wage growth in Denmark, but for a much smaller 10 percent of above-average growth in Norway, and for only about 8 percent of above-average growth in Sweden. If instead the question is how much of the gap in real wage growth between Scandinavia and Britain was due to schooling, the answers are only slightly bigger: 18 percent for Denmark, 12 percent for Norway and 9 percent for Sweden. Some readers may view these as "big" numbers, but we view them as "small", especially given that they are upper bounds.[8]

Schooling mattered to Scandinavian catch up, but other forces mattered far more, especially in Sweden, an ironic result given that Sandberg's thesis was first motivated by Swedish experience.

4. WAS WICKSELL RIGHT? MASS MIGRATION AND CATCH-UP

The Issues

In the early 1880s, Knut Wicksell, then a relatively young economic theorist and neo-Malthusian, asserted that emigration would solve the pauper problem which blighted labor-abundant and land-scarce Swedish agriculture (Wicksell, 1882 cited in Karlstrom, 1985, p. 1). His pro-emigration agitation was followed by other voices in the 1890s, including Adrian Molin and Gustav Sundbarg. Tests of Wicksell's assertion were very slow in coming despite the intensity of the debate on the economic impact of the late 19th century mass migrations. While the early quantitative literature was thick on the determinants of Swedish emigration (Wilkinson, 1967; Quigley, 1972; Williamson, 1974; Rundblom and Norman, 1976; Carlsson, 1976; Moe, 1977), it was thin on the impact of emigration. Indeed, older

[8]These schooling calculations are based on country enrollment rate differentials and the 0.361 estimated coefficient reported in Table 4. They are much smaller if the literacy differentials and the 0.440 estimated coefficient are used, ranging from 1 to 2 percent. Furthermore, schooling explains none of the convergence of Scandinavia on the United States since the latter had higher literacy and enrollment rates. Thus, the text overstates the contribution of schooling to late 19th century Scandinavian convergence.

surveys by Semmingsen (1960, 1972) and Hvidt (1966) had almost nothing to say about impact at all.[9] Two decades later, things are now changing. That statement holds true for more than just Sweden (Karlstrom, 1985; Taylor and Williamson, 1994) since, until recently, the same could have been said of other major emigrating countries like Norway (Riis and Thonstad, 1989; Taylor and Williamson, 1994) or Ireland (Williamson, 1994; Boyer, Hatton and O'Rourke, 1994; Taylor and Williamson, 1994) as well as the major immigrating countries (Williamson, 1974; O'Rourke, Williamson and Hatton, 1994; Pope and Withers, 1994; Taylor and Williamson, 1994).

Did the emigrations have a big impact on the labor force at home? Scandinavian emigration rates reached their peak in the 1880s, and at that time they were among the highest in Europe, exceeded only by Ireland and the rest of the United Kingdom. The rate for the decade was 95.2 per thousand of the population in Norway, 70.1 per thousand in Sweden and 39.4 per thousand in Denmark (Hatton and Williamson, 1994a, Table 1.1): Sweden lay in the middle of the Scandinavian range. Emigration went through booms and busts, but by 1910 the Danish population was 11 percent below what it would have been in the absence of the emigrations over the four decades following 1870, the Swedish population was 15 percent lower and Norwegian population 19 percent lower (Taylor and Williamson 1994, Table 1). Since emigration favored young adults with high labor participation rates, the impact on the home labor force was even bigger than on the home population. We estimate that the Swedish labor force was 18.1 percent smaller in 1910 than it would have been in the absence of emigration (HIER, Appendix Table 6.1).[10] Thus, the influence of emigration on Sweden and the rest of Scandinavia was not trivial.

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[9]An article in an economic history journal on "impact" had no historical content at all (Ekberg, 1977). However, a very sophisticated survey by Scott (1960) did have things to say about impact, but in the end the author could only account for the absence of such work by the fact that "... it is easier to trace the rise in wages than it is to relate it to emigration (1960, p. 167)."

[10] We ignore the possibility that the Swedish natural rate of increase would have been lower in the absence of emigration (by later marriages and lower fertility within marriage). This is called the "Walker Effect" in America, and we guess such effects would have been small. Yet the assumption serves to exaggerate the impact of mass migration on convergence.

There are two questions we can pose of these mass migrations. How much of Swedish (Norwegian or Danish) real wage and labor productivity growth can be assigned to emigration, the outmigrations having helped create labor scarcity at home?[11] How much of the Swedish (Norwegian or Danish) catch-up can be assigned to mass migration, the latter including both the emigrations from poor Sweden and the immigrations (of Swedes and non-Swedes) into the rich New World, like the United States (where most of the Swedes and the rest of the Scandinavian emigrants went)? Our interest is in the second question, but the answers would in any case employ the same methodology: estimate the labor force in a counterfactual no-migration environment for both the sending and receiving country; with the counterfactual labor force estimate in hand, assess the impact of the altered labor force on living standards and productivity by the application of some model of the sending and receiving economies; finally, compute the share of the measured living standards and productivity catch-up explained by the mass migrations.

One way to make the assessment is to invoke partial equilibrium, as illustrated by Figure 2. Here we plot labor-scarce New World wages on the right, labor-abundant Old World wages on the left and "world" labor supplies along the horizontal axis. L_{1890} is the actual labor force distribution in 1890 between the two regions, L^* is the distribution that would have been optimal (e.g., where the wage gap would have disappeared), and L^*-L_{1890} is the mass migration which would have been necessary to erase the wage gap entirely. Figure 2 is drawn to reflect the true wage gap between Old World and New in 1890, that is, the latter more than double the

[11] We focus on diminishing returns and ignore arguments that emigration involved a net export of human capital per capita from Sweden. How bad is our assumption? Wicksell thought emigration was second best to fertility control since parental resources used to raise children were then wasted when the children "defaulted" on the intergenerational contract by emigrating to the New World (Karlstrom, 1985, p. 153; Scott, 1960, p. 170). Indeed, Rudolf Kjellen, a member of Riksdag, reckoned that each emigrant was worth 5,000 kroner and deplored the loss of 20,000 to 25,000 times that number each year (Scott, 1960, p. 164). But didn't the emigrants also send equal or greater remittances back home? Don't we need that evidence to assess the relevance of Wicksell's assertion? We have been unable to find any pre-1914 Swedish remittance evidence, but Scott (1960, p. 164) reports lots of evidence drawn from the 1930s when remittances amounted to about 25 percent of the total balance of payments, a good return on those child-rearing investment costs embodied in Swedes living abroad.

former. With Figure 2, estimates of Swedish emigration and estimates of US immigration in hand, it is a simple matter to pose the counterfactual questions: How big would the 1910 American-Swedish (or Anglo-Swedish) wage gap have been in the absence of the mass migrations in to and out of both countries? What share of the observed American-Swedish (or Anglo-Swedish) wage gap decline between 1870 and 1910 can be explained, therefore, by the mass migrations?

Using a partial equilibrium approach, Alan Taylor and one of the present authors (Taylor and Williamson 1994) concluded the following: mass migration accounted for about a fifth of the Swedish real wage convergence on the United States between 1870 and 1910, for a little more than a third of the Danish convergence, and for almost half of the Norwegian convergence.[12] As we shall see, the mass migrations will have accounted for a far smaller share of the Anglo-Scandinavian catch-up since Britain had emigration rates much like Scandinavia.

Taylor and Williamson take great pains to point out the limitations of partial equilibrium analysis and suggest that computable general equilibrium (CGE) models offer a better way to assess the problem. Computable general equilibrium models are certainly not new to economists since they have become common in development, international trade and public finance.[13] Since the early 1970s, economic historians have also been finding many useful applications, including most recently the problem of convergence. Computable general equilibrium models have been used successfully to estimate the impact of Irish immigration on British labor

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[12]We can illustrate these calculations by using the Norwegian case. Real wages in the USA were 115 in 1870 and 170 in 1910 (where Britain in 1905 equals 100), while they were 28 and 70 in Norway in those two years. The wage gap between these two countries in 1870 was [115-28]/28 = 3.11 while it had fallen to [170-70]/70 = 1.43 in 1910. In the absence of mass migration, it would have "only" fallen to [195-60]/60 = 2.25. Thus, of the observed fall in the wage gap (3.11-1.43 = 1.68), mass migration accounts for almost half (counterfactual minus actual = 2.25-1.43 = 0.82, which when divided by 1.68 is 48.8 percent). In short, about half of the impressive Norwegian catch up on the USA was due to Norwegian emigration and American immigration, or so says the partial equilibrium analysis.

[13]There are various surveys available in the literature. Kemal Dervis, Jaime DeMelo and Sherman Robinson (1982) offer one for development. John Shoven and John Whalley (1984) offer another for trade and public finance, as well as a more recent overview (1992). John James (1984) and Mark Thomas (1987) offer others for economic history.

markets between 1821 and 1861 (Williamson 1990: Chp. 6), to assess the impact of emigration on Irish agriculture from 1856 to 1876 (O'Rourke 1991) and on the Irish economy from 1850 to 1914 (Boyer, Hatton and O'Rourke 1994), to evaluate the effects of immigration on United States labor markets (Williamson 1974) and to identify the impact of United States immigration and British emigration on convergence between them (O'Rourke, Williamson and Hatton 1994). A pioneering CGE application by Urban Karlstrom (1985) estimated that the Swedish emigrations in the 1870s and 1880s served to raise real wages there by 4.9 percent per decade. With the collaboration of Timothy Hatton, the present authors used Karlstrom's result to suggest that the mass migrations might have accounted for about a quarter of the impressive contraction of the American-Swedish wage gap between 1870 and 1910 (O'Rourke, Williamson and Hatton 1994), a figure a little bigger but surprisingly close to the partial equilibrium estimate offered by Taylor and Williamson (1994).

This section builds on Karlstrom's pioneering work by using what we hope is a better Swedish CGE model in an effort to sharpen our answers to Wicksell's question.

A CGE Model for Sweden

The same CGE will be used throughout this essay. Only the basic attributes of the CGE are highlighted here since the reader can find the details elsewhere (HIER, Appendix 5).

Karlstrom's model had five sectors: agriculture (including forestry and fishing), an export-oriented industry (mining and metals, wood products, pulp, paper and printing), a home-market oriented industry (textiles and clothing, leather and rubber goods, chemicals, utilities, stone, clay, glass and food products), services, and construction. Since the Swedish model used here will also be applied to trade issues and since the international price experience was so different within Swedish "agriculture", Karlstrom's agricultural sector was split into tillage, pasture, and forestry plus fishing. Karlstrom's export-oriented and home-market oriented industrial sectors have been retained as is, but his services and construction sectors have been collapsed into a single non-

traded sector. There are thus six sectors in our Swedish CGE model, as opposed to five in Karlstrom's.

Two goods are imported which are not produced at home, foreign vegetable and foreign animal products. There are four primary factors of production: raw labor, capital, land specific to pasture and land specific to tillage. Swedish production functions are taken to be CES (constant elasticity of substitution), and there are detailed intermediate input-output relationships.

It seems to us that capital moved fairly freely between sectors in late 19th century Sweden, seeking out highest returns. The same was not true of labor, however. Farm labor was reluctant to move and thus wage gaps between city and countryside were common, and they often widened during supply-side slumps in agriculture at home or during demand-side booms in manufacturing at home or abroad. The model reflects these real world factor market forces. While capital moves freely between sectors, farm labor moves to the best urban jobs only with reluctance: labor responds to rural-urban wage gaps, but sluggishly. This formulation allows labor to be mobile between town and country, while at the same time allowing for the existence of persistent (and endogenous) rural-urban wage gaps.[14] Land, of course, is only used in agriculture, and it is specific to either tillage or pasture so that we can assess the impact of various events on grain-producers versus animal-producers.

Sweden is viewed as a small country who took prices of tradables as determined in world markets (e.g., England). Sweden could and did impose tariffs, but apart from that world prices in London, Liverpool and Manchester plus or minus transport costs determined home prices of sawn lumber, butter, wheat, iron products, cotton textiles, pulp, herring and all the other tradables that passed over the Swedish border. Indeed, one of our main goals is to assess the impact of exogenous changes in transport

[14]Wage gaps are common during development, and they have been analyzed over time and across countries (Hatton and Williamson 1991, 1992). The treatment in the text is consistent with these earlier findings.

costs, tariffs and world market conditions on Swedish convergence.[15]

The Swedish CGE model is estimated for 1871, and the trade deficit she ran at that time is taken to be exogenous.

With the model in hand, we can now use it to uncover the sources of Swedish convergence in the late 19th century, starting with emigration.

The Impact of Mass Migration on Swedish Catch-Up

The CGE model estimates that the emigration between 1870 and 1910 served to raise urban wages in 1910 by 12.3 percent above what they would have been in its absence (HIER, Appendix Table 6.2). Urban unskilled wages in Sweden actually increased by 191 percent (34.3 to 99.7) over the four decades.[16] The 12.3 percent looks pretty small by comparison, not much more than a twentieth of the total. Granted, Wicksell was talking about rural poverty, but the CGE model predicts an even smaller impact on farm wages, 11.8 percent. Neither of these figures seem big enough to confirm Wicksell's optimistic assessment of emigration.

But what about as a share of the catch-up with Britain or the United States? Table 5 shows that, while not spectacular, the impact of mass migration on the rapidly contracting wage gap between Britain and Sweden was significant, almost 11 percent of the catch-up. That is, the Anglo-Swedish wage gap fell by 94.3 percentage points between 1870 (100%) and 1910 (5.7%), and migration accounted for 10.1 percentage points of it. We don't have to search far to find the reason why the figure isn't a lot bigger: Britain recorded an emigration rate not too far below that of Sweden (and the rest of Scandinavia). So far, it looks like Wicksell was just plain wrong: emigration did not make a big contribution to Anglo-Swedish catch-up (although, as we shall see, it was equal to or even bigger than the contribution of schooling). But what about Swedish catch-up with

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[15] There are two technical twists that are reported at length in the HIER working paper: we invoke what is known as the Armington assumption to distinguish the imports of home-market manufactures from similar and competing goods produced at home; and we invoke a similar assumption to distinguish export goods sent abroad from similar goods consumed at home.

[16] Like the urban real wage growth rates in Table 1, these are based on three year averages centered on 1870 and 1910.

the United States, the country which absorbed 98 percent of the Swedish emigrants?[17] The immigration rate in late 19th century United States was enormous, and its cumulative impact was to make the 1910 labor force there 21 percent higher than it would have been in its absence, making urban wages 15.1 percent lower than they would have been without the immigration (HIER, Appendix Table 6.4). The American-Swedish wage gap fell by 159.3 percentage points between 1870 (229.2%) and 1910 (69.9%), and mass migration accounted for about half of it (80.3 percentage points).

It looks like Wicksell was only half right.

5. Was Solow Right? Foreign Capital Imports and Catch-Up

Wicksell may have thought emigration mattered, but we suspect that Robert Solow (1956) and some Scandinavian historians would have guessed that international capital flows mattered even more.

We know that Britain exported capital abroad at rates far exceeding anything before or since (Edelstein 1982), and we know that Sweden absorbed exceptionally heavy doses of foreign capital (although not from Britain). Foreign capital was directed into Swedish cities and the railroads, and it was in response to government demand (Karlstrom 1985: 22). A lively book written by Karl Jungenfelt almost forty years ago states Solow's hypothesis with assertiveness (Jungenfelt 1966: with English summary):

> "One of the most important factors in international economic relations during the nineteenth century was the international migration of capital. In the case of Sweden, the fifty years between 1860 and 1910 witnessed an import of foreign capital which in all probability was a vital prerequisite for the country's rapid economic upswing ... the fact that the inflow of foreign capital was used by the government did not detract from its significance for the economy as a whole. In turning to foreign countries to finance the most capital-absorbing operations of the time, the government released

[17] Hatton and Williamson (1994b, Chapter 4). The United States absorbed 90 percent of the Danish emigrants and 97 percent of the Norwegian emigrants.

> domestic savings for the use of private business ... the influx of foreign capital was one of the main prerequisites for the expansion of the Swedish economy throughout practically the whole period ending with the outbreak of the First World War" (Jungenfelt 1966: 210-11 and 247-8).

Most of these capital inflows were used to finance social overhead construction and France was the main market for the Swedish bond issues.

Elsewhere we have shown how important the British capital export and the Swedish capital import were for their respective capital stocks.[18] Capital imports over the four decades following 1870 served to make the 1910 Swedish capital stock 50.1 percent bigger than it would have been in its absence. Capital exports served to make the 1910 British capital stock 20.4 percent smaller than it would have been in its absence. The United States was a much more modest capital importer than was Sweden (US capital imports served to augment her 1910 capital stock by only 0.3 percent, even though the contribution was much larger during long swing booms, like the 1880s), so global capital market contributions to Swedish catch-up must have been much more important to the Anglo-Swedish case.

The CGE model estimates that international capital flows served to raise urban wages in Sweden by 25.2 percent over what they would have been in their absence, to raise them by 0.1 percent in the United States, and to lower them in Britain by 7.3 percent (HIER, Appendix Tables 6.2-6.4). Surely this mattered to Swedish catch-up, and Table 5 tells us by how much. International capital flows appear to account for 51.9 percentage points of the 94.3 percentage point decline in the Anglo-Swedish wage gap between 1870 and 1910, or more than a half. They appear to account for 66 percentage points of the 159.3 percentage point decline in the American-Swedish wage gap, or more than four-tenths. These results must be viewed as upper bounds since, after all, we have ignored the possibilities that:

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[18] HIER, Appendix Table 6.1. We rely here on the new net capital flow estimates which were published in graphic form by Lennart Schon (1989), the underlying time series for which was generously supplied to us by the author. We ignore the possibility that domestic savings would have risen in Sweden had foreign capital imports been absent and that domestic savings would have fallen in Britain had foreign capital exports stayed home. In that sense, we exaggerate the impact of capital flows on convergence, although our guess is that the exaggeration is modest.

British domestic savings might well have contracted in the absence of those spectacular foreign capital export possibilities; Swedish domestic savings might well have expanded in the absence of what must have appeared to be an elastic supply of foreign capital. Upper bounds, then; but very big nevertheless.

Differential rates of capital deepening matter in accounting for Swedish catch-up on Britain and America between 1870 and 1910. A very large share of the differences in capital deepening is explained by mass migrations and international capital mobility. The two combined[19] appear to account for almost two-thirds of the Swedish catch-up on Britain and for more than eight-tenths of the Swedish catch-up on America. This too must be viewed as an upper bound. After all, we have ignored the possibility of domestic savings responses and that: Swedish population and thus labor force growth might well have contracted had there not been an expanding American midwestern frontier to absorb them as emigrants; and American native-born population and labor force growth might well have quickened had there not been what appeared to be an elastic supply of European emigrants competing in local labor markets. Upper bounds, again: but enormous nevertheless.

Solow was right: capital-deepening induced by global factor mobility explains the vast majority of the spectacular Swedish catch-up in the late 19th century. This is a surprising result given that there has been so much talk about technological catch-up as an explanation for convergence in the late 19th century Atlantic economy (Gerschenkron 1962; Abramovitz 1986), and so little talk about the role of global factor markets. It is also surprising given the literature on the "failure" of Victorian Britain which asserted that capital accumulation didn't much matter (McCloskey 1970).

6. Were Heckscher and Ohlin Right? Trade and Catch-Up

The factor-price-equalization theorem has been a durable tool for

[19]By "combined", we mean simply the addition of these effects, not the joint counterfactual where both migration and capital inflows are allowed to have their impact simultaneously. The same is true of the "total open economy forces" in Table 5.

trade theorists ever since Eli Heckscher and Bertil Ohlin made their seminal contributions in 1919 and 1924 (Flam and Flanders 1991). The Heckscher-Ohlin paradigm argues that countries export commodities which use intensively the factors in which they are well endowed while they import commodities which use intensively the factors in which they are poorly endowed. Under restrictive assumptions, it can be shown that a move from no trade to free trade can in fact equalize factor prices where wide differences existed before, but it was convergence not equalization that held the interests of Heckscher and Ohlin. Let falling transport costs 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: that is, trade can be a substitute for labor and capital mobility in generating wage or labor productivity convergence.

Heckscher and Ohlin were writing just after the late 19th century Scandinavian catch-up, and they were motivated by the commodity price convergence which they thought had taken place in the Atlantic economy. Their economic metaphor was driven by primary foodstuffs: the New World grain invasion, carried by the sharp decline in transport costs, served to lower the relative price of grains in Britain and Scandinavia, and to raise it in America. Britain did not respond to the challenge with tariffs, although countries on the continent did (including Sweden: Kindleberger 1951). What occurred in the late 19th century was exactly the kind of exogenous relative price shock which is supposed to set factor-price convergence in motion.

In spite of the durability of the factor-price-equalization theorem, nobody, until very recently, thought to explore its empirical relevance for the epoch which motivated Heckscher and Ohlin in the first place. The exception is our own work on Anglo-America where we found that it mattered a great deal (O'Rourke and Williamson 1994).

There was certainly trans-Atlantic commodity price convergence. The classic example is offered by the grain market. Liverpool was, of course, the major port handling Britain's grain trade while Chicago was the city

closest to America's grain producers, so it is the Liverpool-Chicago price gap that mattered most. Liverpool prices exceeded Chicago prices 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. The price convergence was also manifested by beef, pork, bacon, mutton, butter, bar iron, cotton textiles, coal, copper, hides, wool, tin, cotton and many other tradables (O'Rourke and Williamson 1994, Table 2, Panel B). Thus, the price differential on US exportable foodstuffs fell from 51.9 in 1870 to 10.6 percent in 1913; that on US importable manufactures fell from 56.6 to 8.9 percent; that on UK importable foodstuffs fell from 56.8 to 11.4 percent; that on UK exportable manufactures fell from 31.3 to 2.6 percent; and that on tradable intermediates fell from 13.3 to 9.7 percent.

Had there been no other forces at work, the terms of trade between manufactures and foodstuffs would have changed dramatically in both countries. If Britain had absorbed all of the transport-induced price shock, her terms of trade would have almost doubled. If America had absorbed all of the transport-induced price shock, her terms of trade would have more than doubled. These were very big price shocks, and they had a big impact on Anglo-American convergence. Commodity price convergence explains about two thirds of the decline in the Anglo-American real wage gap over the quarter century ending in 1895. Over the full period 1870-1913, it explains all of the Anglo-American convergence! That is, Heckscher-Ohlin forces by themselves would have produced a far bigger Anglo-American real wage convergence than the actual real wage convergence observed, 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 divergence forces set in motion by Edwardian industrial failure in Britain and Chandlerian industrial success in America (O'Rourke and Williamson 1994, Table 3).

But what about Scandinavia, and Sweden in particular? How much of the impressive Anglo-Swedish and American-Swedish convergence can be explained by commodity price convergence, trade creation and those Heckscher-Ohlin

forces? To the extent that Sweden retreated behind tariff walls in the 1880s, perhaps the price convergence set in motion by the global collapse in international transport costs was muted or even offset (Kindleberger 1951; Kuuse 1971; O'Rourke, Taylor and Williamson 1993). On average, Scandinavia was a wee bit more protectionist than her neighbors, with Denmark being more open, and Norway and Finland more closed. Swedish tariff rates on wheat (at least by 1913: Estevadeoral 1993) were half those of her European neighbors, not so unlike the Danish free trade position on wheat; Norway was far, far more protectionist on grain. As far as manufacturing goes (cotton yarn, cloth, bar iron and sheet iron), Scandinavia was a bit more protectionist than her European neighbors, but Sweden was the biggest Scandinavian protectionist, while Denmark was more free trade and Norway in the middle. In short, Sweden was a bit more protectionist than her neighbors, but it wasn't grains she was protecting, it was manufactures.

Since we know that Anglo-American tradable prices converged, we need only document the evolution of Anglo-Swedish price gaps to say something about both Anglo-Swedish and American-Swedish factor price convergence. Easier said than done, but what we can say is summarized in Figures 3-7 for the sectors that correspond to the CGE. According to the calculated trend, the price gap for vegetable products (barley, oats, wheat, potatoes) fell from about 55 percent in 1870 to about 17 percent in 1910, in spite of tariffs. Adding to this the trans-Atlantic spread between Liverpool and Chicago suggests that American-Swedish vegetable price gaps must have fallen from almost 110 percent to less than 30 percent, an enormous price convergence. The experience of animal products (beef, pork and butter) was similar, declining from about 40 percent (higher in Britain) in 1870 to almost zero in 1910. The experience of the forestry sector (hewn timber) also conforms to Heckscher-Ohlin hunches, the price gap there falling from more than 145 percent in 1870 to less than 70 percent in 1910. In contrast, the price gap between Britain and Sweden in the home-market-oriented industries (wheat flour, cotton yarn) fell only modestly from about plus 10 percent in 1870 to about minus 5 percent in 1910, perhaps reflecting the effects of rising tariffs.

The big surprise, however, lies with the export industries (iron

products, steel products, wood products and copper). As Figure 6 confirms, there is no evidence of price convergence over the full forty years! We confess that this finding was puzzling enough to force us back to the data several times, but with the same results.[20] As we shall see, it matters.

There was price convergence between Sweden and Britain over the late 19th century, as the former integrated into the global commodity market with the latter at its center. It follows that Sweden also underwent price convergence with North America, that Denmark (the free trader) must have undergone somewhat more price convergence and that Norway (the protectionist) must have undergone somewhat less. We repeat, however, that price convergence was much more modest for Swedish home-market-oriented industries (the import-competing industries) and non-existent for the export industries. Already this suggests that the Heckscher-Ohlin factor price convergence effects must also have been modest.

What impact did this Swedish commodity market integration into the global economy have on catch-up? We use the same CGE to assess the question, exactly the kind of model first suggested by Bertil Ohlin and now so commonly used in trade theory to illustrate his insights. The 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 (HIER, Appendix Table 6.6). Table 5 tells us how small a contribution commodity price convergence made to the decline in the Anglo-Swedish wage gap, not even 4 percent. We have not directly made the same assessment for the decline in the American-Swedish wage gap, but adding the known large trans-Atlantic Heckscher-Ohlin effects to the small Anglo-Swedish ones estimated here[21] implies a big American-Swedish figure of more than four-tenths.

Heckscher and Ohlin were right: commodity price convergence generated

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[20]We are still working on these data, but they reflect a classic index number problem. How do you accommodate the appearance of two very important new export products in the middle of the period, pulp and steel?

[21] O'Rourke, Williamson and Hatton (1994: Table 10.2, panel C) estimate that Heckscher-Ohlin price shocks reduced the US wage advantage over Britain by about 19.5 percentage points. A similar figure was derived earlier by the present authors (O'Rourke and Williamson 1994).

factor price convergence. The irony, however, is that these two Swedes developed a trade model which explains so little of late nineteenth century Swedish convergence on Britain.[22] Heckscher and Ohlin thinking appears to be more relevant in explaining Swedish convergence on America.

7. Good Luck? Global Price Shocks and Catch-Up

Heckscher and Ohlin were talking about one kind of price shock, the one associated with commodity price convergence, commodity market integration, trade creation and factor price convergence. This kind of price shock is shared by all trading partners and it contributes to real wage and labor productivity convergence. As we have seen, it did contribute to late 19th century Scandinavian convergence on Britain, but the impact was surprisingly modest. What about other global events which influenced Scandinavian prices but which had nothing to do with commodity market integration? Was Scandinavia also lucky by specializing in products the relative prices of which boomed during the late 19th century? If so, could this good luck have given Scandinavia an additional catch-up kick?

The literature makes much of the role of foreign trade (Karlstrom, 1985, pp. 14, 40), and -- Denmark aside -- this means the exports of wood products, iron ore and shipping. What happened to the relative price of these and other Scandinavian exports after controlling for the impact of declining transport costs and commodity price convergence? Much of the literature seems to ignore these issues, and looks only at Scandinavian supply and export responses to British and Continental demand expansion (e. g., Flinn (1954) on iron mining and British steel; Fritz (1980), Kaukiainen (1980), Hornby and Nilsson (1980) on the evolution of the Norwegian, Finnish and Swedish shipping industries). While studies of Scandinavian export sectors seem to ignore price shocks and their origin, this is not true of what was to become by the 1880s a critical import-competing sector, grains. Conventional wisdom has it that the Repeal of the Corn Laws opened

[22]This Swedish irony is also confirmed by an econometric assessment of trends in the wage-rental ratio in the Atlantic economy (O'Rourke, Taylor and Williamson 1993).

the doors for Swedish grains from the 1840s to the 1870s, and that this helped Swedish agriculture. Indeed, it is argued that the induced expansion of home grains retained labor and suppressed emigration. By the middle of our period, however, Swedish agriculture had been badly hit by grain competition from North America and Russia, inducing agricultural depression and emigration (Holgersson, 1974; Norrie, 1979; Kuuse, 1971). True, grain-producers suffered from these world price shocks, but they were trade-creating shocks which favored Swedish catch-up.

The task here is to factor out alleged good luck from the influence of Heckscher-Ohlin commodity price convergence. When that task is completed, what stands out is the performance of the export industries (HIER, Figures 13 and 18). While there was hardly any change in the Anglo-Swedish price gap between 1870 and 1910, the real price of exports plunged by almost 30 percent (HIER, Appendix 4). The real price of importables fell too, but not nearly as much.

Where's the evidence of "good luck" and booming foreign demand which was supposed to have benefitted Sweden and thus contributed to the catch-up? Indeed, was this not "bad luck" which Sweden had to overcome?

Our model's small country assumptions and comparative statics are unlikely to deal adequately with these important questions. Could it not be argued that Sweden faced downward sloping demand curves for exportables like pulp and iron products, and that Sweden was undergoing rapid productivity advance (and transport development) which served to shift Swedish supplies of exportables rapidly to the right? As long as demand was not price inelastic, rapid rightward supply shifts of exportables would have driven down export prices but would still have contributed to growth. If it can be confirmed that late 19th century Swedish exports should be viewed in this way, then the CGE would need revision to confront these additional questions. That task is left for the future.

8. Bottom Line: Sources of the Scandinavian Catch-Up

The living standard and productivity gap between poor Sweden and rich Britain and America collapsed between 1870 and 1910. About two-thirds of

the Swedish catching up on Britain was due to the open economy forces of global factor and commodity market integration. All of the Swedish catching up on America was due to the same open economy forces. The question for the economist is: Why does the new growth theory spend so little time dealing with these open economy forces? The question for the economic historian is: Why don't we spend more time exploring two potential corollaries? Can the breakdown of global factor and commodity markets after 1914 explain a large share of the cessation of convergence up to 1950? Can the spectacular OECD convergence achieved after 1950 be explained by the resumption of the pre-1914 open economy conditions that contributed so much to Swedish catch-up?

Table 6 suggests that the sources of Swedish catch-up can be generalized to the rest of Scandinavia. Judging solely by their emigration rates, and assuming the same elasticities implied by the Swedish CGE, mass migration must have contributed much less to Danish convergence (5%) but much more to Norwegian convergence (19%). From what we know about capital flows, their contribution to Danish convergence was likely to have been considerably smaller (Johansen, 1985, pp. 230-223; Hansen, 1970, pp. 59-64; Jorberg, 1970, pp. 478-9) with Norway somewhere in between (Riis and Thonstad, 1989). Although Norwegian capital imports were even larger than for Sweden after 1890, Norway was actually a net capital exporter 1870-1890, so the net impact of foreign capital on wage convergence over the period as a whole was a bit smaller (36%) than for Sweden (55%). The figure for Denmark was about the same as Norway; 38% of the Danish convergence on Britain is explained by foreign capital flows. From what we know about tariff policy, the Heckscher-Ohlin effects must have been much bigger in Denmark but smaller in Norway. When all is said and done, open economy forces accounted for about two-thirds of the catch up in Sweden, a little more than half in Norway, and about half in Denmark. The relative importance of the three open economy forces certainly varied between them, however. A bigger contribution for trade and a smaller contribution for foreign factor flows in Denmark; a smaller contribution for trade and a bigger contribution for factor flows in both Norway and Sweden; exactly the kind of substitution between trade and international factor mobility that Heckscher and Ohlin envisioned.

When the estimated role of schooling and literacy is added to the narrative in Table 6, something like two-thirds to three-quarters of the spectacular Scandinavian catch-up can be explained by fairly conventional forces pre-dating the new growth theory by at least sixty years. Furthermore, most of those forces have their origin in increasingly well integrated world factor and commodity markets. In short, late 19th century globalization was a central carrier of Scandinavian catch up.

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TABLE 1

Relative Economic Performance of Scandinavia in the Late 19th Century: Growth per annum (%)

Country	(1) Real Wage Per Urban Worker 1870-1913	(2) Wage-Rental Ratio 1870-1910	(3) Real GNP Per Capita 1870-1913	(4) Real GDP Per Worker-Hour 1870-1913
Denmark	2.62	2.85	2.19	1.90
Finland	na	na	1.19	1.80
Norway	2.41	na	1.35	1.65
Sweden	2.70	2.45	2.39	1.74
Scandinavian Average	2.58	2.65	1.78	1.77
Austria	na	na	1.15	1.76
Belgium	1.05	na	1.05	1.24
France	0.65	1.80	1.06	1.58
Germany	1.08	0.87	1.30	1.88
Great Britain	1.09	2.54	1.00	1.23
Ireland	1.42	4.39	na	na
Italy	1.76	na	0.81	1.65
The Netherlands	0.76	na	0.93	1.34
Portugal	0.53	na	0.18	na
Spain	0.00	-1.04	0.25	na
Switzerland	na	na	1.32	1.46
Non-Scandinavian Europe Average	0.93	1.71	0.91	1.52
Argentina	0.96	-4.06	na	na
Australia	0.02	-3.30	na	1.08
Canada	1.86	na	na	2.31
USA	0.90	-1.72	na	1.93
New World Average	0.94	-3.03	na	1.77

Notes and Sources. All averages are unweighted. Col. (1): real wage rate for unskilled urban workers, from Williamson (1995, Table A2.1). Col. (2): ratio of Williamson's wage to land values per unit of farmland, from O'Rourke, Taylor and Williamson (1993, Table 3). Col. (3): gross national product in constant prices, per capita, from Bairoch (1976, Table 6). Col. (4): gross domestic product in constant prices, per worker-hour, from Maddison (1991, Table C.11).

TABLE 2

Unconditional Convergence Regressions for the Late 19th Century

Sample	$\hat{\beta}$ on log 1870 value	R^2	N	λ
1870-1913, real wage Figure 1	-0.390 (2.290)	0.27	16	0.011
1870-1913, GDP per worker	-0.376 (3.280)	0.52	12	0.011
1870-1913, GNP per capita	-0.126 (0.398)	0.16	11	0.003

Source: See text.

TABLE 3

School Enrollment and Literacy Rates in the 1870s to 1890s

Country	(1) O'Rourke-Williamson Enrollment Rate Estimates	(2) O'Rourke-Williamson Literacy Rate Estimates	(3) Prados et al. Enrollment Rate Estimates
Denmark	0.70	0.99	0.51
Finland	0.10	0.89	0.15
Norway	0.64	0.98	0.47
Sweden	0.65	0.98	0.48
Scandinavian Average			
with Finland	0.52	0.96	0.40
without Finland	0.66	0.98	0.49
Austria	0.59	0.66	0.42
Belgium	0.56	0.86	0.41
France	0.80	0.96	0.55
Germany	0.73	0.97	0.51
Great Britain	0.53	0.96	0.40
Ireland	0.45	0.91	n.a.
Italy	0.37	0.47	0.26
The Netherlands	0.65	0.97	0.47
Portugal	0.23	0.38	0.16
Spain	0.46	0.86	0.32
Switzerland	0.77	0.99	0.57
Non-Scandinavian Europe Average			
with the Mediterranean Basin	0.56	0.82	0.41
without the Mediterranean Basin	0.64	0.91	0.48
Argentina	0.20	0.46	n.a.
Australia	0.84	0.97	n.a.
Canada	0.80	0.90	n.a.
USA	0.93	0.88	n.a.
New World Average			
with Argentina	0.69	0.80	n.a.
without Argentina	0.86	0.92	n.a.

Notes and Sources: Columns (1) and (2) are described in HIER (Appendix 1 and 2). Column (3) was supplied by Leandro Prados, and his data is the "escolar" variable underlying the regressions conditional on schooling (Prados, Sanchez and Oliva 1993).

TABLE 4

Conditional Convergence Regressions for the Late 19th Century: Adding Schooling or Literacy

Sample	$\hat{\beta}$ on log 1870 value	$\hat{\beta}$ on log schooling variable	R^2	N	λ
1. Using O'Rourke-Williamson Enrollment Rate Estimates:					
1870-1913, real wage	-0.522 (3.059)	0.361 (1.930)	0.43	16	0.017
1870-1913, GDP per worker	-0.425 (4.250)	0.099 (1.305)	0.61	15	0.013
2. Using O'Rourke-Williamson Literacy Rate Estimates:					
1870-1913, real wage	-0.476 (2.839)	0.440 (1.702)	0.41	16	0.015
1870-1913, GDP per worker	-0.386 (4.546)	0.304 (1.801)	0.65	15	0.011

Source: See text.

Table 5

Open Economy Forces and Scandinavian Catch-Up 1870-1910

Source	1870	1910	1910 - 1870	
Anglo-Swedish Wage Gap				
Actual	100.0%	5.7%	-94.3%	(100.0)
Due to:				
[1] Mass migration	100.0	89.9	-10.1	(10.7)
[2] Foreign capital flows	100.0	48.1	-51.9	(55.0)
Labor and capital flows combined (= [1]+[2])	**100.0**	**40.1**	**-59.9**	**(63.5)**
[3] Commodity market integration (price convergence)	100.0	96.3	-3.7	(3.9)
Total open economy convergence forces	**100.0**	**37.9**	**-62.1**	**(65.9)**
[4] Residual	100.0	67.8	-32.2	(34.1)
American-Swedish Wage Gap				
Actual	229.2	69.9	-159.3	(100.0)
Due to:				
[1] Mass migration	229.2	148.9	-80.3	(50.4)
[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	160.1	-69.1	(43.4)
Total open economy convergence forces	**229.2**	**57.1**	**-172.1**	**(All)**
[4] Residual	229.2	229.2	(None)	(None)

Note: Actual is calculated as 3-year averages centered on 1870 and 1910, from Williamson (1995, Table A2.1). Wage gaps are calculated as the percent by which the countries exceeded Sweden. Thus, for 1870, the Anglo-Swedish gap was (68.67-34.33)/34.33 = 1.0003 or 100%. The underlying wage data are:

	Sweden	USA	Britain		Sweden	USA	Britain
1869	42	107	69	1909	96	172	107
1870	28	115	69	1910	100	170	105
1871	33	117	68	1911	103	166	104
Ave	34.33	113.00	68.67	Ave	99.67	169.33	105.33

See text and HIER, Appendix 6 for sources. Totals in the table may not add up exactly due to rounding.

Table 6

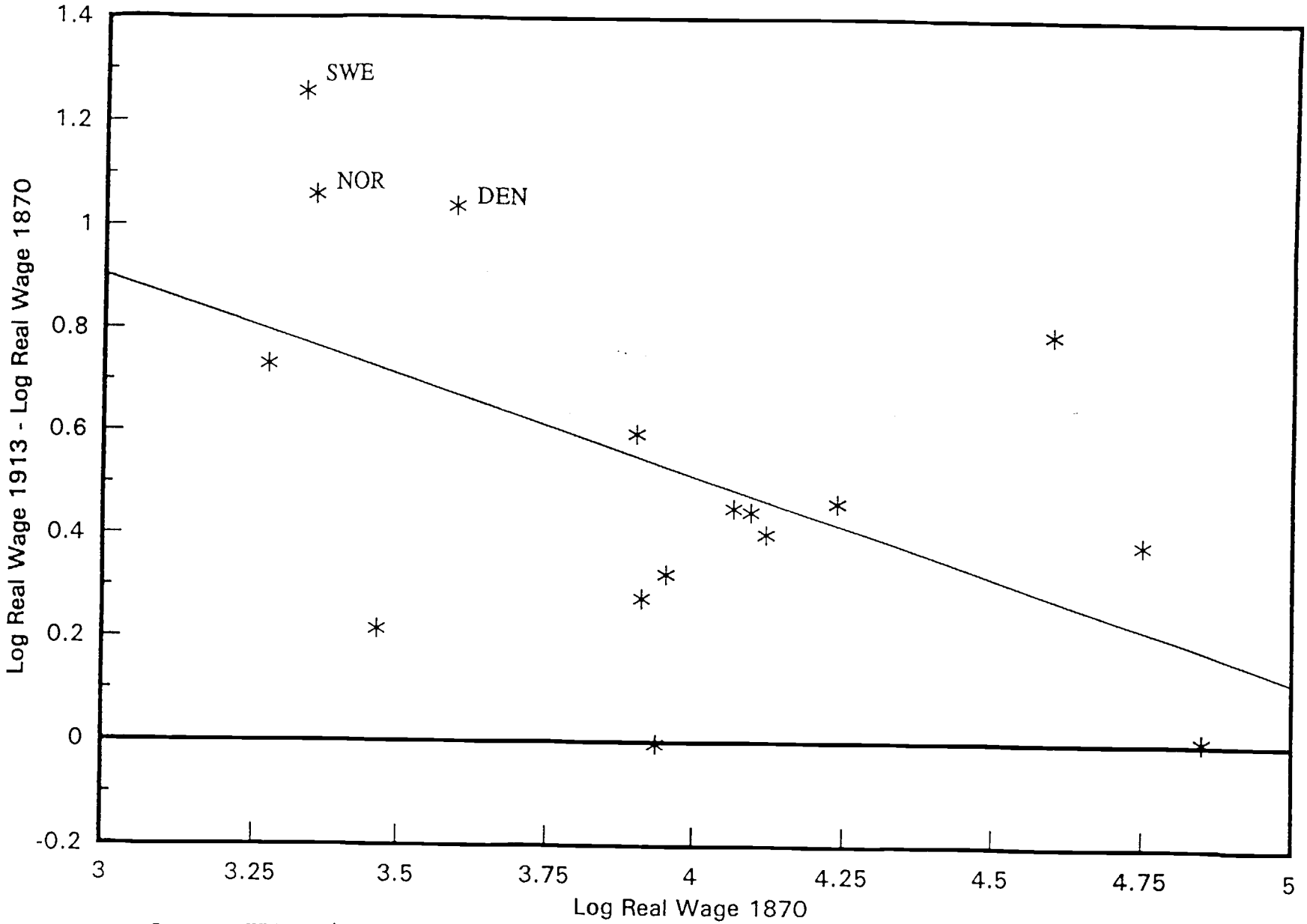
The Bottom Line:
Sources of Scandinavian Catch-Up on Britain 1870-1910

	Declining Anglo-Scandinavian Wage Gap With:		
Shares explained by:	Denmark	Sweden	Norway
[1] Mass migration	5%	11%	19%
[2] Foreign capital flows	38	55	36
[3] Commodity market integration (price convergence)	> 4	4	< 4
Total open economy convergence forces	**50?**	**66+**	**55+?**
[4] Schooling and literacy	18	9	12
Residual:domestic-financed capital deepening, technological catch-up and other mysteries	**32?**	**25?**	**33?**

Note: Totals may not add up to components above them due to rounding. The figures for Sweden come from Table 5. Those for Denmark and Norway in rows [1] and [2] are derived by assuming that the same wage-factor flow elasticity implied by the Swedish CGE also applied to Danish and Norwegian factor flows, although the wage gaps and factor flows were themselves different of course.

Figure 1

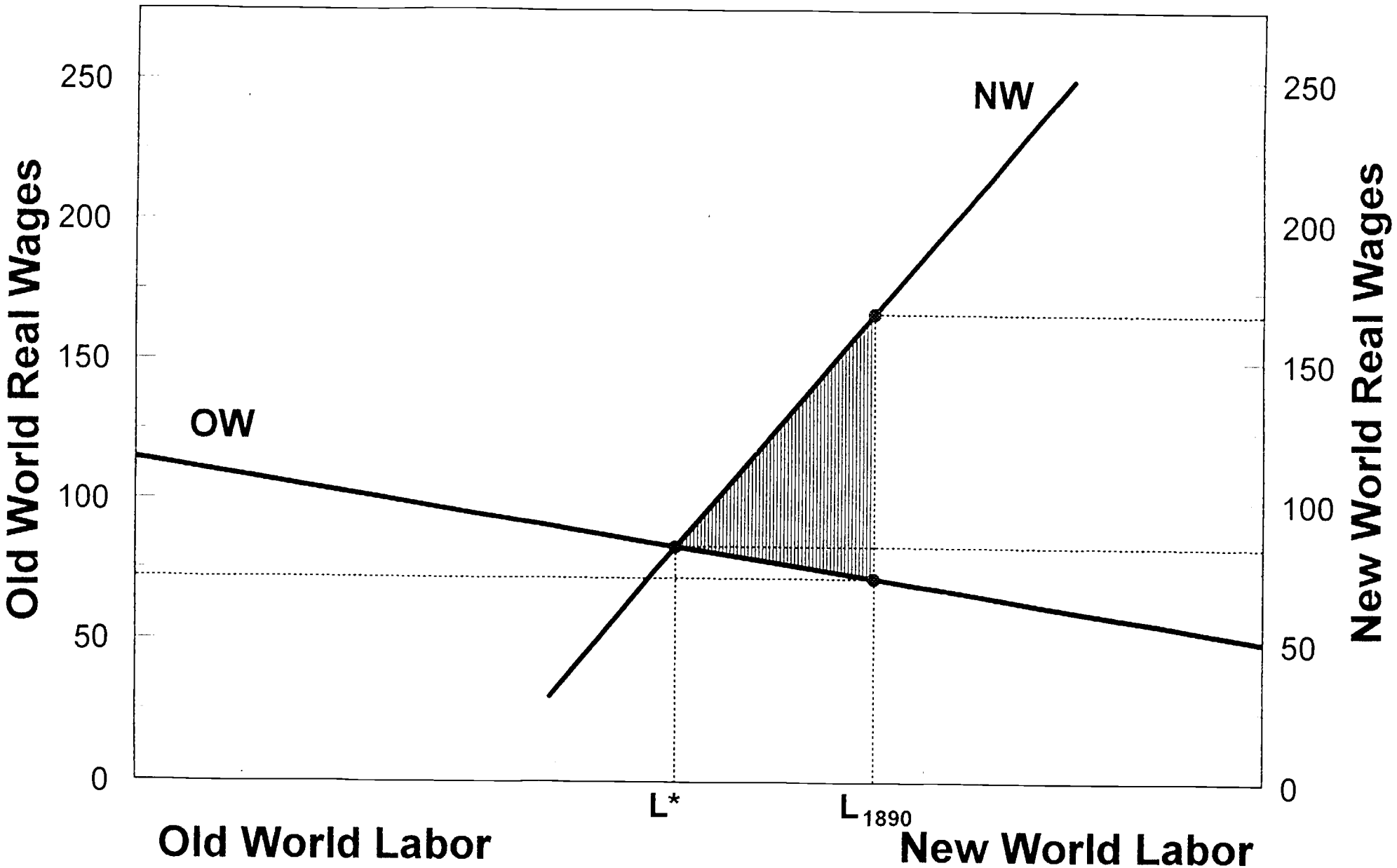
"Unconditional" Real Wage Convergence, 1870-1913



Source: HIER, Figure 1.

Figure 2

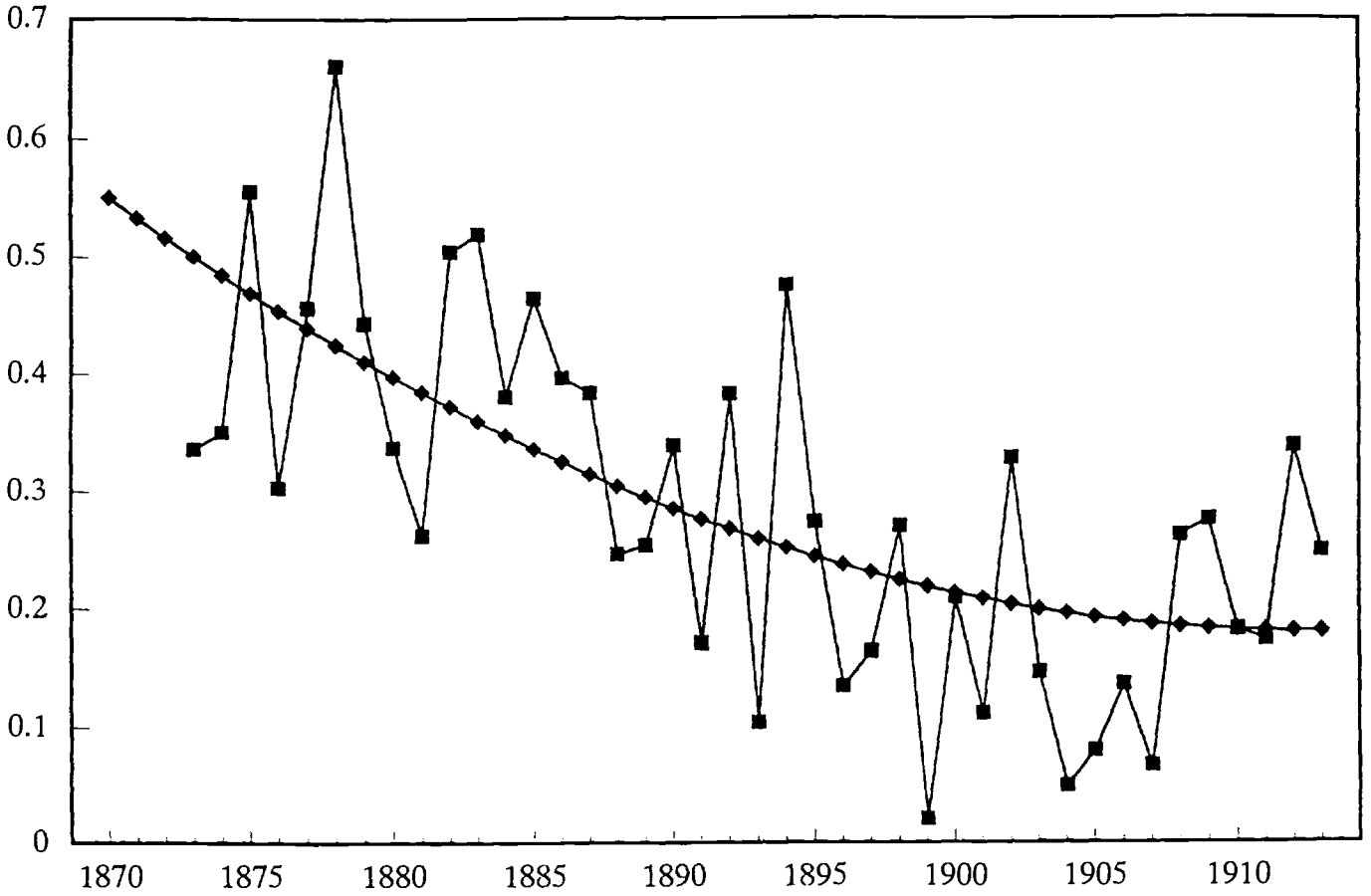
Labor Demand and Wages in the Old and New World c1890



Note: Real wages are weighted by average share of population (1890-1899). Source: HIER, Figure 9.

Figure 3

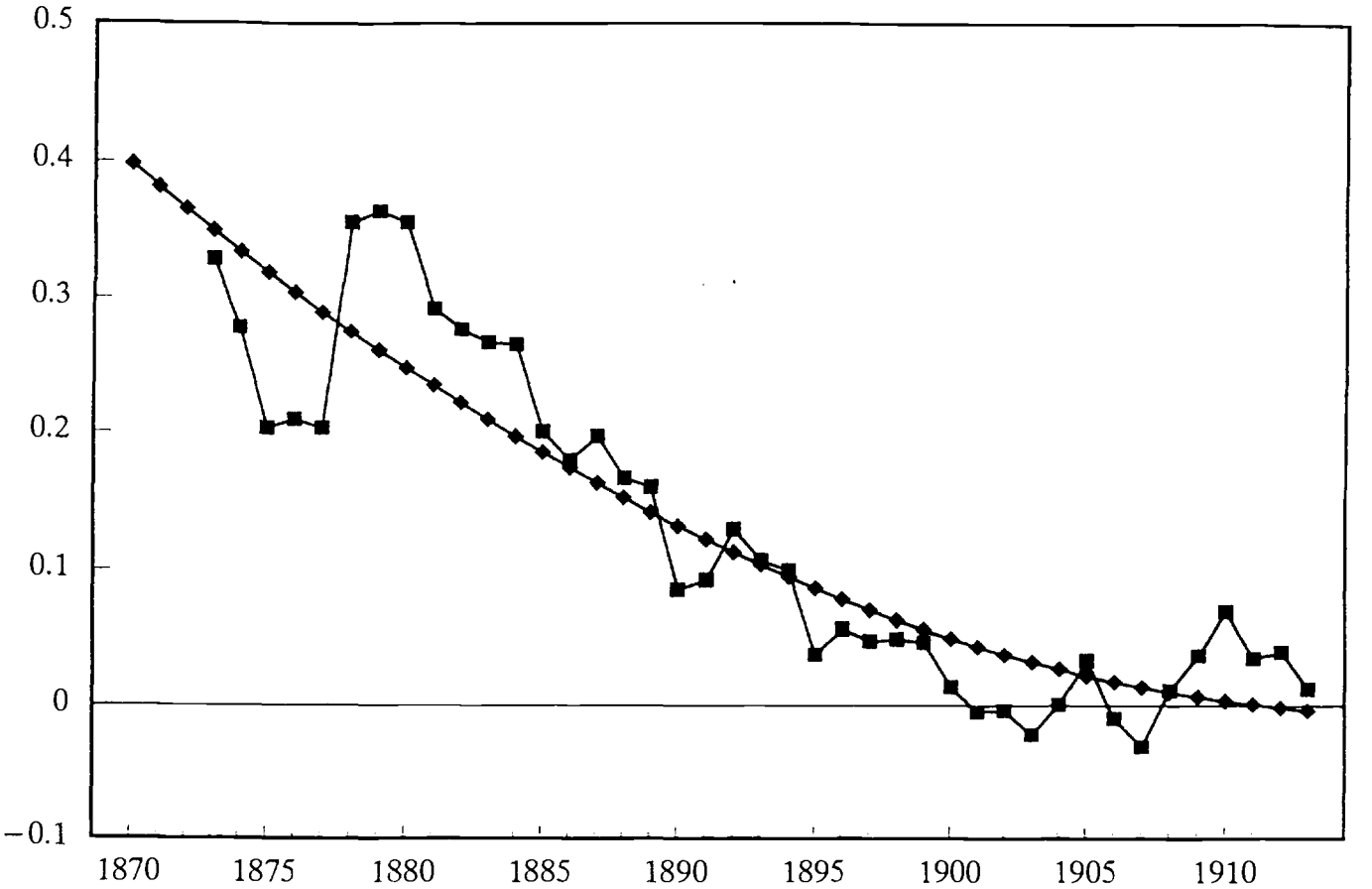
Vegetable Sector Anglo-Swedish Price Gap 1870-1913



Source: HIER, Figure 10. The fitted values are derived from a quadratic trend estimated from the actual data 1873-1913. The gap is calculated as (Britain-Sweden)/Sweden using 1891 Swedish trade weights.

Figure 4

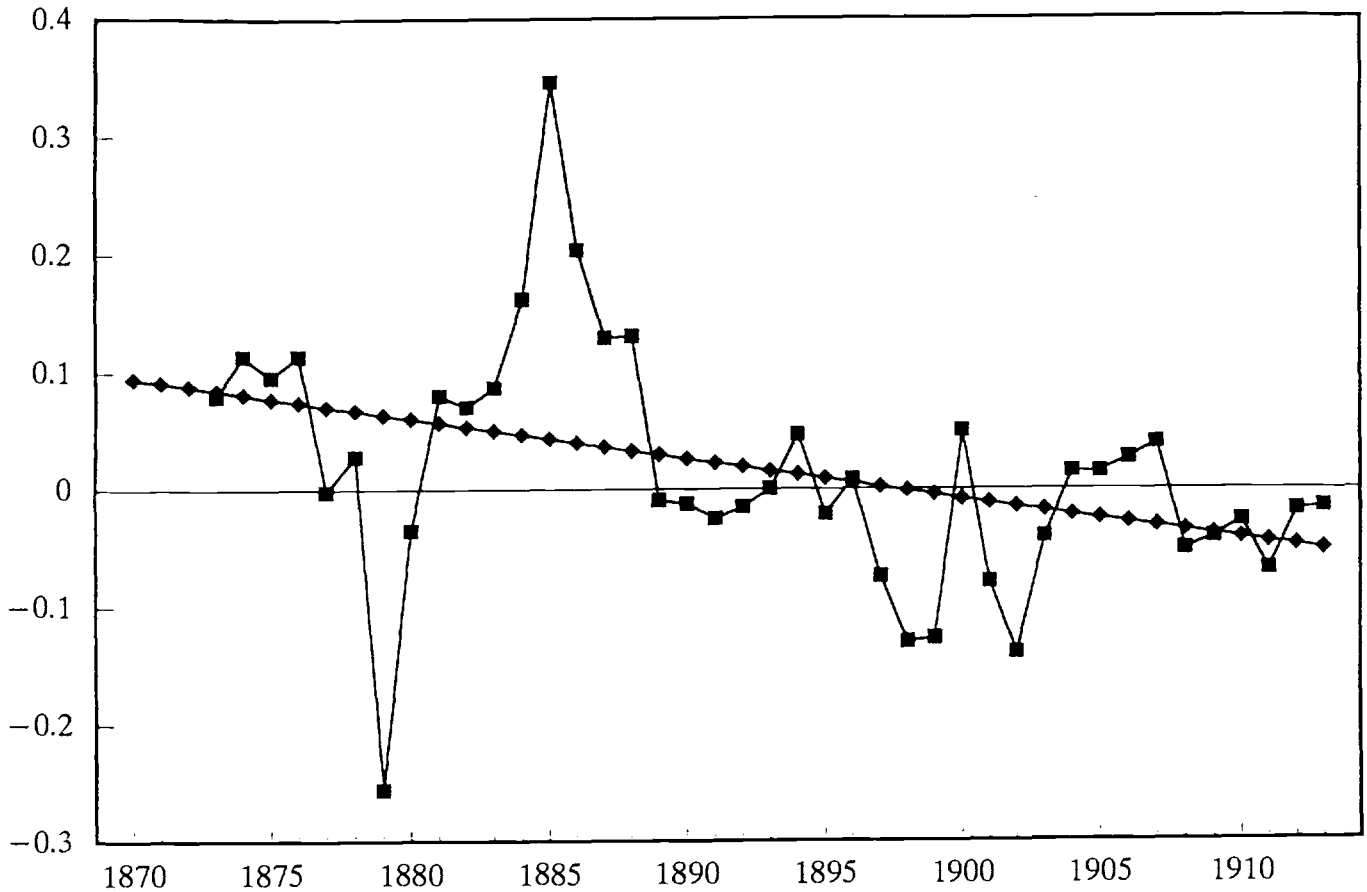
Animal Products Sector Anglo-Swedish Price Gap 1870-1913



Source: HIER, Figure 11. The fitted values are derived from a quadratic trend estimated from the actual data 1873-1913. The gap is calculated as (Britain-Sweden)/Sweden using 1891/5 Swedish trade weights.

Figure 5

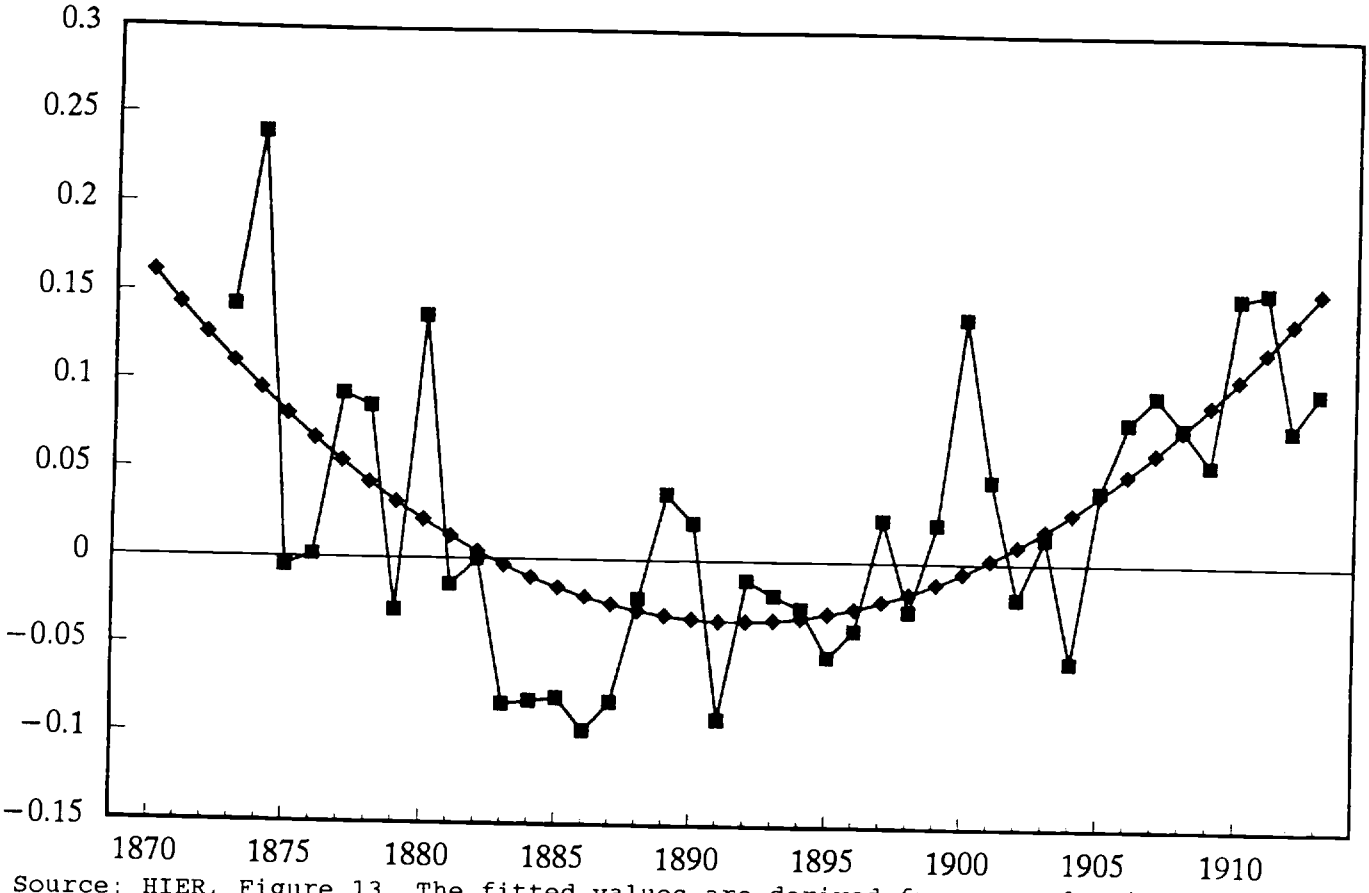
Home Market Oriented Industries Anglo-Swedish Price Gap 1870-1913



Source: HIER, Figure 12. The fitted values are derived from a quadratic trend estimated from the actual data 1873-1913. The gap is calculated as (Britain-Sweden)/Sweden using 1891/5 Swedish trade weights.

Figure 6

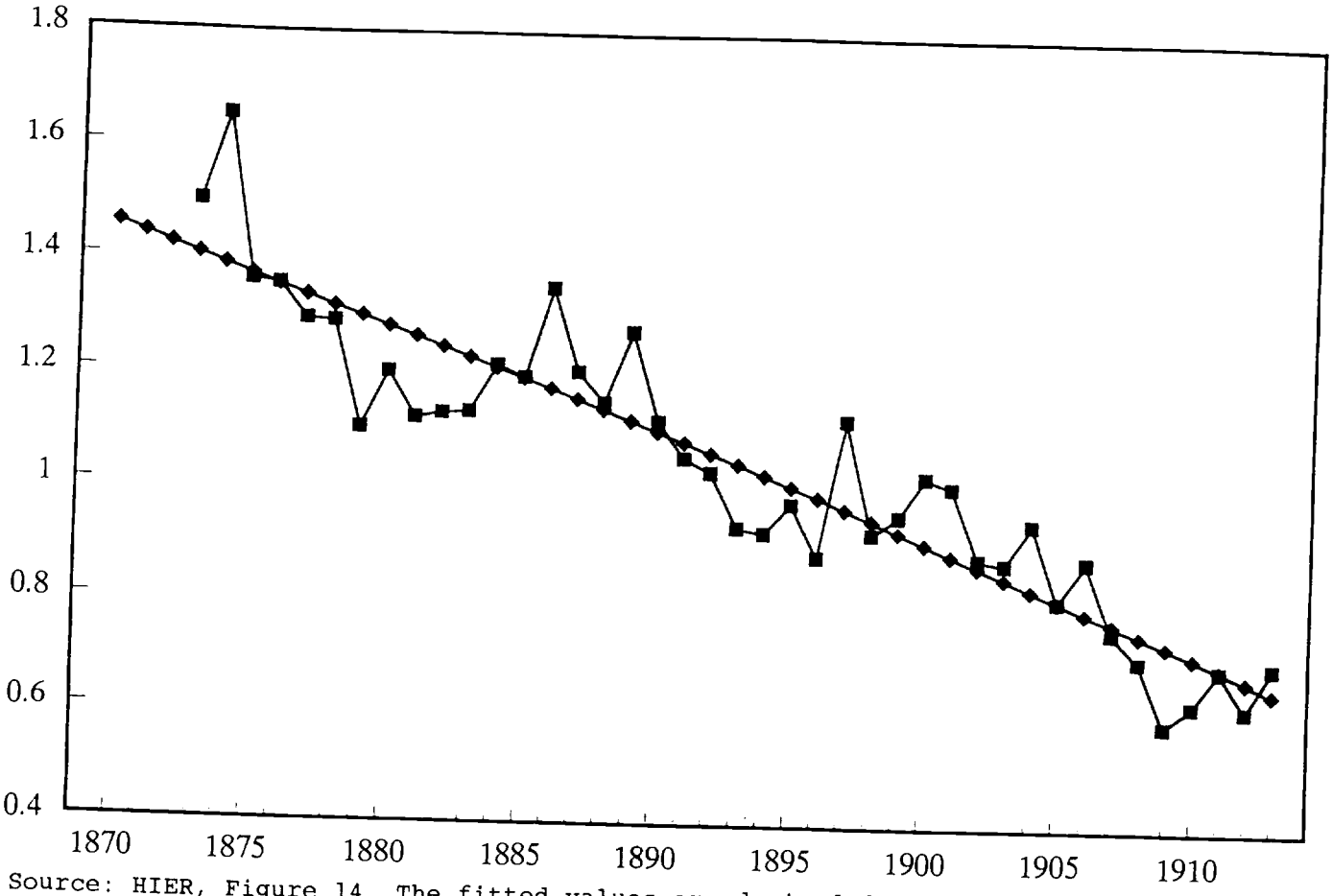
Export Industries Sector Anglo-Swedish Price Gap 1870-1913



Source: HIER, Figure 13. The fitted values are derived from a quadratic trend estimated from the actual data 1873-1913. The gap is calculated as (Britain-Sweden)/Sweden using 1891/5 Swedish trade weights.

Figure 7

Forestry Sector Anglo-Swedish Price Gap 1870-1913



Source: HIER, Figure 14. The fitted values are derived from a quadratic trend estimated from the actual data 1873-1913. The gap is calculated as (Britain-Sweden)/Sweden and it is based solely on hewn timber prices.