Discussion Paper Series

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Discussion Paper No. 1433
April 1989

Paper to be given at the Second World Congress of Cliometrics, Santander, Spain (June 24-27, 1989). Comments invited, but please do not quote.

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I. THE PROBLEM

Nominal wage gaps between farm and city employment are one of the most pervasive aspects of modern economic growth. So much so that they have become a key stylized fact of development economics. Indeed, a good portion of the literature on the Third World has focused on this problem at length, both in terms of labor market behavior and in terms of policy formation in the face of factor market distortions. Yet, wage gaps are not simply an institutional peculiarity of newly industrializing Third World countries since they seem to have been even bigger among 19th and 20th century western nations. While unskilled full-time nominal city wages are about 41 percent higher than farm wages in the contemporary Third World (Squire, 1981, Table 30, p. 102), they were about 51 percent higher among late 19th century industrializers (Clark, 1957, Table II, pp. 526-531). They were even higher in England in the 1830s, about 73 percent (Williamson, 1987, Table 3, p. 52). Furthermore, the evidence suggests that these wage gaps may widen over time: they rose from 29 to 41 percent in the American North between the antebellum and postbellum periods (Williamson, 1988, Table 11), were about 50 percent by the mid 1890s in the US as a whole, a figure which reached an all-time U.S. high of about 65 percent by the late 1930s.

Are these nominal wage gaps evidence of some massive market failure? One would have thought that economic historians would have shown more interest in this question, especially given the amount of attention that development economists have paid to it since the early 1950s, and given that the farm sector was still one fifth of the U.S. labor force as late as 1940.

Actually, there are three questions which these wage gaps raise, not just one. First, would these nominal full-time wage gaps disappear if properly measured? Proper measurement would include the fact that cities are more costly places to live, that cities may have greater disamenties, that farmers also make in-kind payments to their workers, and that farm laborers suffer seasonal underemployment. If the wage gaps survive improved measurement, then a second question becomes relevant: Are we observing equilibrium annual real earnings differentials, or are they true manifestations of disequilibrium distortions? One of the most popular arguments for the equilibrium differentials view can be found in the Todaro model, a pillar of development economics for twenty years. Perhaps because of limited time series data, this model has never been adequately tested, but it makes the plausible assertion that sticky industrial wages, urban unemployment, and flexible farm wages jointly account for the wage gap. Given the dominance of the model in the Third World literature, it may come as a surprise to learn that the idea has its intellectual roots in United States experience during the interwar period where the evidence is abundant to test it, but it appears that no one has ever done so. Finally, if equilibrium models cannot fully account for these wage gaps, we can move on to the third question: What accounts for these wage distortions, and for their variation over time?

This paper will focus on all three questions, but our main objective is to explain United States experience with the ratio of farm to unskilled urban weekly wages plotted in Figure 1. There are two wage ratios reported there, one in nominal terms and the other in real terms, the latter accounting for the fact that in 1941, for example, the city cost of living was 30 percent higher than the farm cost of living (Koffsky, 1949). The series which will attract our attention for the remainder of the paper is the real wage ratio, and its variance over the half century is striking. Why did the farm/nonfarm wage ratio rise so persistently from the relatively low levels in the mid-1890s to the end of World War I, collapse so dramatically in the immediate postwar years so as to fall even below their late 19th century levels in the 1920s, and then plunge to even lower levels in the 1930s? In the pre-World War I years, real farm wages were almost 70 percent of real unskilled city wages. In the 1920s they had fallen to a little more than 60 percent of real unskilled city wages, while in the late 1930s the figure was around 45 percent.

What accounts for these large wage gaps and their increase over time? Was there a switch in labor market regimes between the pre-war and interwar decades, or can macroeconomic forces fully account for the downward drift in the farm/nonfarm wage ratio after World War I?

II. DEBATES OVER WAGE GAPS IN DEVELOPMENT ECONOMICS

Hagen's "Dynamic" Distortions. By 1958, the early pioneers in development economics had a full appreciation of wage gaps, and they were central to debates over development strategy. Everett Hagen (1958) published an influential paper in that year on "An Economic Justification of Protectionism". Based on evidence drawn both from advanced and underdeveloped countries, he concluded that: "The agricultural-urban wage differential exists in underdeveloped and economically advanced countries alike; the available evidence suggests that it does not disappear, or even diminish, in the course of development. It is a persistent long-run phenomenon (Hagen, 1958, p. 503)." Hagen's priors were very strong. He felt that these wage differentials were the result of unbalanced growth in the derived demand for labor. Rapid industrialization creates an excess demand for labor in urban sectors while a lagging agriculture creates an excess supply in rural sectors. Since migration is never adequate to fully clear these two markets in any one year, and since the unbalanced growth persists year in and year out, a disequilibrium wage distortion will emerge. The more rapid the rate of unbalanced growth, the bigger the distortion. Only in advanced economies where the industrial revolution is complete do rural-urban labor markets have an opportunity to erase those gaps, but even then large terms of trade shocks (like those of the 1930s) may matter.

Establishing the argument that wage gaps reflected true wage distortions was central to Hagen's agenda since they helped support a policy of active intervention to foster industrialization. Recall that the exports-as-engine-of-growth thesis had been badly damaged by the interwar collapse of Third World primary product markets, and that import-substitution was the favored policy of the 1950s. Hagen's arguments tended to support the new view of history offered by Ragnar Nurkse, Gunnar Myrdal, Raoul Prebisch, and Hans Singer, all of whom argued that Third World primary product exports were no longer the engine of growth that they had been up to World War I, and that industrialization through import substitution was the best policy route to follow. By appealing to wage distortions, Hagen could offer support for the infant industry argument for protection, leaning heavily on the theoretical contributions of Haberler and Viner. Since those wage distortions tended to price domestic manufacturers out of their own markets (artificially raising labor costs), government intervention to offset the distortion was warranted.

Some economists offered other explanations for the wage gaps, while still favoring the view that they were true distortions. Others were skeptical, and felt that the wage gaps were likely to be the spurious result of mis-measurement. Jagdish Bhagwati and V. K. Ramaswami (1963) expressed such skepticism in their important paper "Domestic Distortions, Tariffs and the Theory of Optimum Subsidy", but they also helped clarify the possible sources of a true distortion. In addition to Hagen's focus on "dynamic" distortions, Bhagwati and Ramaswami appealed to trade unions, government employment and minimum wage legislation (an argument later pursued by Jacob Mincer, 1976).

<u>Distortions and Economic Dualism</u>. While Hagen offered "dynamic" distortions which he felt accompanied every successful industrial revolution, another active group of development economists invoked more elegant explanations for these wage distortions, the source of which lay with agricultural institutions. These came to be known as models of economic dualism, and they implied that the wage distortions would persist as long as pre-industrial agricultural institutions persisted well into early industrialization.

The dualistic model had its source with Sir Arthur Lewis's (1954) labor surplus model, and it came to be formalized both in a neo-classical (Jorgenson, 1961; Kelley, Williamson, and Cheatham, 1972) and a classical fashion (Fei and Ranis, 1961). The argument supporting wage gaps in such models was based on the view that pre-commercial family subsistence farms in the Third World "paid" each member their average, rather than their marginal, product. As a result, capitalist industry had to pay a wage which insured a spread between sectoral marginal products. The distortion implied market failure which warranted government intervention. Note, however, that the dualistic model need not generate wage gaps, but rather only gaps in marginal products. To get wage gaps as well, these models had to appeal to any or all of the forces already listed above.

<u>Unemployment and Equilibrium Gaps</u>. The dualistic model had a very optimistic view of the development process. Given elastic labor supplies from the countryside, industrialization could proceed where the only constraint was the rate of accumulation. Labor was transferred from low marginal productivity in the countryside to high marginal productivity in the city, and all of these models implied that the rate of labor absorption in city employment would be fast. As the 1960s unfolded, a more gloomy view began

to emerge. The rate of labor absorption in Third World cities was far slower than the rapid rate of accumulation would have predicted and, even more alarming, urban unemployment became more and more pronounced. The appearance of overt urban unemployment created two camps who tried to explain it: there were those who argued that rural labor was being pushed by Malthusian forces into the cities at a rate too fast for their absorption in good industrial jobs, a view which implied that wage gaps and urban unemployment should have increased; and there were those who argued that urban labor market distortions could account for both the rising unemployment and the increased wage gaps.

W. Arthur Lewis was the first development economist to bring attention to urban unemployment in the Third World. It appears prominantly in his 1965 Richard T. Ely lecture to the American Economic Association where he sketched out the following argument (Lewis, 1965, pp. 12-13): Attracted by an apparently irrational optimism that they will be selected for those scarce high-wage city jobs, the rural emigrants keep coming, and the glut spills over into urban unemployment. By focusing on <u>expected</u> rather than current wage gaps, Michael Todaro (1969) developed a framework which formalized Lewis's argument. The Todaro framework and its extensions (Harris and Todaro, 1970; Stiglitz, 1974; Corden and Findlay, 1975; Cole and Sanders, 1985) enjoyed considerable popularity over the two decades which followed.[1]

The Todaro hypothesis is simple and elegant. While similar statements can be found sprinkled through the development literature, the most effective illustration can be found in Max Corden and Ronald Findlay (1975), reproduced in Figure 2. There are only two sectors analyzed in Figure 2, but they are sufficient to illustrate the point. Under the extreme assumption of wage equalization through migration, and in the absence of wage rigidities, equilibrium is achieved at E (the point of intersection of the two labor demand curves, AA' and MM'). Here wages are equalized at $w_A^* = w_M^*$, and the share of the total labor force, L, employed in urban jobs is $O_M L_M^*$, where M denotes manufacturing and A denotes agriculture. Since wages are not equalized in the contemporary Third World, the Todaro model incorporates the widely-held belief that the wage rate in manufacturing is pegged at artificially high levels by unions, by minimum wage legislation, or by private sector emulation of inflated public sector wage rates, say at $\bar{w}_M$. If, for the moment, we ignore urban unemployment, then all those who fail to secure the favored jobs in manufacturing would accept low-wage jobs in agriculture at w_A^{**}. Now let's add the reality of unemployment. Todaro introduces an expectations hypothesis which, in its simplest form, states that the favored jobs are allocated by lottery, that the potential migrant calculates the expected value of that lottery ticket, and compares it with the certain employment in the rural sector. Migration then takes place until the urban expected wage is equated to the rural wage. Given $\bar{w}_M$, at what rural wage would the migrant be indifferent between city and countryside? If the probability of getting the favored job is simply the ratio of L_M to the total urban labor force, L_U, or one minus the unemployment rate, then the expression $w_A = (L_M/L_U)\bar{w}_M = (1-U)\bar{w}_M$ indicates the agricultural wage at which the potential migrant is indifferent about employment locations. This structural equation of migration behavior is in fact the qq' curve in Figure 2. The equilibrium agricultural wage is now given by w_A.[2]

The new equilibrium at Z in Figure 2 offers an explanation for wage gaps observed between city and countryside which competes with the Hagen hypothesis. While Hagen views these wage gaps as a manifestation of dynamic disequilibrium, Todaro does not.

III. 20TH CENTURY AMERICAN WAGE GAPS: SEARCHING FOR CAUSES

Oddly enough, these competing propositions have never been formally tested. Even more surprising, while the Todaro model was constructed to explain a contemporary Third World problem, the proposition has its intellectual roots with agricultural economists who were writing about the American interwar wage gap some forty years ago. Todaro himself was aware of this when he cited U.S. experience with exceptionally large wage differentials in the 1930s (Todaro, 1969, p 140). He also cited Theodore Schultz's <u>Agriculture in an Unstable Economy</u> (1945), but the literature on American interwar wage gaps is far bigger than even Schultz's impressive volume would suggest.

To begin with, these economists focused almost exclusively on interwar wage gaps. Their interest was in farm income parity, and thus compared the 1920s and 1930s with World War I benchmarks where farm income matched up quite well with industrial income. Thus, Daniel Ahearn (1945, pp. 18-21) gives the impression that the wage gap opened up only after 1920, while in fact it appears to have returned to something like late 19th century levels. Similarly, Louis Ducoff (1944, p. 135) decries the lack of "parity" between incomes of hired farm workers and nonfarm wage earners in the 1930s, using the far more favorable 1910-1914 period as his base. An excellent study by Howard Parsons (1952) ad[illegible] similar stance restricting his analysis solely to the years 1910-1945. This [illegible] fixation is somewhat surprising given that in his 1930 book <u>Real Wage[illegible] ited States 1890-1926</u> Paul Douglas devoted a whole chapter to the parti[illegible] se in the wage gap from the early 1890s to World War I. Furthermore, we [illegible] that the wage gap between farm and city increased markedly over the [illegible] s or so prior to 1890 (Williamson, 1988). In short, the wage gap [illegible] d wide variance over the seven decades

1870-1941, and that variance was not solely a manifestation of interwar instability and the Great Depression.

What accounts for the variance in the wage gap? The interwar literature offers three explanations.

First. In the tradition of Hagen's disequilibrium distortions, both Ahearn (1945, pp. 89-179) and Parsons (1952, pp. 5-6) stressed the role of the terms of trade in commodity markets in driving the wage gap, although their work was anticipated by Warren and Pearson (1924) some twenty years before. The argument is simple enough. When world price shocks twist the commodity terms of trade against agriculture, farm wages suffer. If the decline in the terms of trade persists, and if the rate of rural emigration is sluggish, then not only will the wage gap persist but it will tend to increase. This disequilbrium view is supported by the gross correlation between falling wage gaps and improving farm terms of trade from the 1890s to World War I, and the reversal of those trends in the 1920s and 1930s.

Second. Like so many authors writing on this topic at that time, Ahearn (1945, p. 35) made much of elastic rural labor supplies. However, it is not at all clear how this explanation can account for the variance in wage gaps over time. After all, there is no evidence which supports a slow-down in rural labor supply growth from the 1890s to World War I and a speed-up thereafter. However, there is an alternative labor supply source which might help account for the variance in wage gaps -- foreign immigration into American cities. After all, there was a striking surge in American immigration from a trough in the early 1890s to a peak just prior to World War I. This glut in urban labor markets would have tended to erase the wage gaps. Similarly, the post-War quotas choked off immigration to American cities, thus increasing urban labor scarcity and augmenting the wage gaps. Like the terms of trade argument, the immigration argument falls into the Hagen disequilibrium tradition, thus supporting the view that some portion of the wage gaps represent true distortions.

Third. Anticipating Todaro, Ducoff dwelt at length on the role of urban unemployment concluding that "farm wage rates have been highly vulnerable to the recurring cyles of mass urban unemployment" (Ducoff, 1944, p. 190), and he offered some persuasive evidence to support the proposition for the years 1929-1943 (Ducoff, 1944, Figure 23, p. 187). Parsons (1952, pp. 31-55) built on Ducoff, extending the time series, and stressing the asymmetry in the two labor markets, one with flexible and one with sticky wages:

> In the industrial sector the depression tends to affect the labor market in the form of unemployment with the earnings of those still employed ... tending to remain relatively constant in real terms. In the agricultural economy, on the other hand, wages are affected adversely while employment is not affected to an appreciable extent (Parsons, 1952, p. 43).

This Todaro tradition was further extended by Willis Weatherford, who argued:

> When industrial unemployment rises above its trend, farm wages fall below their trend. When unemployment is high, the farm labor force stays on the farm, youth postpones leaving the farm, the large labor supply forces farm wages to low levels (Weatherford, 1957, p. 66).

What remains to be done is to test these propositions more formally using time series information covering the period 1890 to 1941. What drove the wage gap between city and countryside over these five decades?

IV. TESTING THE SIMPLEST TODARO EQUILIBRIUM MODEL AND THE PERSISTENCE OF HAGEN DISTORTIONS: 1890-1941

This section explores the simplest possible statement of the Todaro equilibrium model as a structural equation. The test turns out to be successful, so section V will then use it to derive a more comprehensive reduced-form model of "push" and "pull".

We start by comparing trends in the observed real wage ratio with the Todaro-adjusted real wage ratio, $w_A/w_M(1-U)$. The result is plotted in Figure 3. How much of the large and rising discrepancy between the actual wage gap and counterfactual wage equalization can be explained by urban unemployment? It appears that some of the share of the gap can be so explained, but much of it is left unexplained. We call the unexplained residual the "true Hagen disequilibrium distortion".

Two attributes of the wage gap time series persist even after these crude Todaro adjustments are made: first, the abrupt fall in the wage ratio after World War I; and second, the downward drift in the adjusted wage ratio throughout the interwar period. In short, there appears to be a regime switch in regional labor markets around World War I as well as evidence of increasing labor market disequilibrium across the twenties and the thirties. Do disequilibrium shocks and slow adjustment account for this regime switch and a rise in the true Hagen distortions? Alternatively, is it explained by a change in the behavior of farm migrants?

Potential migrants may, of course, have assessed the probabilities of urban unemployment or even its private costs very differently than this crude Todaro adjustment in Figure 3 suggests. The next step, therefore, is to actually estimate the simple Todaro model. To distinguish between short run and long run effects, the structural equation estimated is

$$[1] \quad LRWR = a + b_1 LIU + b_2 LRWR1 + b_3 D + e$$

where LRWR is the log of the current real wage ratio (farm to nonfarm, and nominal wages are deflated by farm and nonfarm cost-of-living indices), LRWR1 is lagged one year, LIU is the log of the current urban employment rate (or one minus the urban unemployment rate), and D is a time dummy (1916-1941 = 1, 0 otherwise) introduced to capture what appears to be a regime switch around World War I. The unemployment variable is defined as the share of the total unemployed in the nonfarm labor force where the unemployment figures are based on Stanley Lebergott's (recently contested) estimates.

The estimates of equation [1] are reported in Table 1. The t-ratios are all large, the DW-statistic is satisfactory, and the adjusted correlation coefficient is high. On this score, the Todaro hypothesis looks good. However, there are thre[illegible] early warning signals that suggest that the simple Todaro equilibrium mo[illegible] inadequate. First, the coefficient on the time dummy implies either a [illegible] switch or that terms of trade or other shocks at the end of World War I [illegible] dated by such slow migration adjustment that the induced glut in farm [illegible] generated a sharp rise in the wage gap over the following two decade[illegible] the coefficient on the lagged RWR implies the presence of very long l[illegible] ration response, long enough to have made true Hagen disequilibrium dist[illegible] ually increase over time. Third, note that the Todaro model argues tha[illegible] n equilibrium, the intercept on this regression should be one as sho[illegible] e coefficient on unemployment. That is, ignoring the dummies and th[illegible] rm,

$$LRWR - b_2 LRWR1 = a + b_1 LIU,$$

and when LRWR = LRWR1 in the long run, then

$$LRWR = a/1-b_2 + [b_1/1-b_2]LIU.$$

Thus, the approriate test for the Todaro model is that $b_1/1-b_2$ and antilog $a/1-b_2$ both be 1.

As Table 2 suggests, the simplest and crudest statement of the Todaro model is only a partial success. Urban unemployment did have a consistent impact on the wage gap through time, and the coefficient on one minus the urban unemployment rate is very close to one, just as Todaro would have predicted. However, true Hagen disequilibrium distortions persist: farm/nonfarm wage ratios fall short of wage equalization by 20 percent in the 1890-1915 period, and 39 percent in the 1916-1941 period. True Hagen disequilibrium distortions rose over the half century, and the Todaro equilibrium view simply does not hold, although urban unemployment did, of course, play a role.

These distortions seem very large, so a little discussion is in order. The critic can not argue that we have ignored the obvious reality that living costs are lower on the farm than in the city since, after all, we have already deflated these earnings estimates. That is, the LHS variable is the real wage ratio. The critic could argue, as one of the present authors did recently (Alston and Hatton, 1988), that in-kind payments on the farm were anywhere from 20 to 40 percent of total renumeration during this period, large enough so that they might have exhausted the measured Hagen distortions in the pre-1916 years or in the 1920s. But it could also be argued that seasonal underemployment in agriculture was equally important and would have offset the advantage of in-kind payments. Based on detailed microeconomic evidence from a

Michigan farm survey in 1894 (Hatton and Williamson, ongoing), the typical farm laborer was unemployed 2-4 months of the year, or perhaps 20-35 percent of the time. Based on the Unemployment Census of 1937, the figure was 19.4 percent a half century later (U.S.Bureau of the Census, 1938, p. 7). To the extent that the disadvantages of seasonal underemployment and the advantages of in-kind payments were approximately offsetting, then the true Hagen distortions measured in Table 2 are likely to be near the mark. In addition, we have said nothing about poor relief. In the thirties at least, poor relief served to take some of the private costs out of urban unemployment, in which case the impact of U is overstated and the true Hagen distortions would be even higher.

Could it be that these results are driven by bad unemployment data? In a recent exchange central to debates over changing macro-instability in the American economy, Christina Romer (1986) and David Wier (1985) both attacked Lebergott's old estimates and offered some new ones. Surprisingly enough, Appendix B shows that our results are not significantly changed by replacing Lebergott's estimates with either Romer's or Weir's. We shall continue, therefore, to use the Lebergott unemployment estimates in what follows.

V. TESTING A VERSION OF THE TODARO MODEL IN "PARTIAL" GENERAL DISEQUILIBRIUM: 1891-1941

So far, we have simply explored the dual to the structural equation of migration behavior underlying the Todaro model. That is, Todaro postulated an off-farm migration process where potential migrants were taken to equate actual real wages on the farm with expected real wages nonfarm. The previous analysis suggests that the process was far more complex. Nonetheless, equation [1] tells us nothing about what forces were driving both the wage gap and the urban unemployment rate. In effect, we have been regressing one endogenous variable on another. Figure 2 suggests that we can do better. Indeed, by using the analysis underlying Figure 2 we can explore some of the issues raised by agricultural economists writing forty years or more ago. What about a collapse in the farm terms of trade, which would shift leftwards the derived demand for farm labor, thus augmenting the wage gap and urban unemployment? What about an exogenous rise in nonfarm wages, which would do the same? And what about foreign immigration to the cities, which would serve to augment total urban unskilled labor supplies, crowd out potential farm immigrants, and increase both the wage gap and the urban unemployment rate?

To get answers to these questions, we need only translate Figure 2 into an explicit reduced-form model. There are four equations underlying Figure 2, and we have kept them simple in what follows: two derived labor demand equations (farm, A, and nonfarm, M), a generalized version of Todaro wage equation, and an identity dealing with labor supplies. They are:

[2] $$L_M = B\left[\frac{W_M}{P_M}\right]^{\beta}$$

[3] $$L_A = A\left[\frac{W_A}{P_A}\right]^{\alpha}$$

[4] $$W_A = \epsilon(1 - U)^{\lambda} W_M$$

[5] $$(1 - U) = \frac{L_M}{(L - L_A)}$$

where L is the total labor force, P_A is the price of farm products, P_M is the price of nonfarm products, α and β are labor demand elasticities (negative in sign, of course), while A and B reflect the impact of technology and the capital stock on capacity. This system of equations is faithful to the Todaro model in three ways: first, it is an equilibrium model; second, the nonfarm wage is determined exogenously; and third, the urban unemployment rate enters into the migrant's expected wage calculation. Equation [4] offers a generalized version of the Todaro wage equation, but when ε and λ both equal 1, we return to his simpler version where $W_A=(1-U)W_M$.

Solving these four equations [2]-[5] is messy due to the presence of nonlinearities, but some helpful assumptions yield the following reduced-form expression (see Appendix A):

$$[6] \qquad \log\left[\frac{W_A/C_A}{W_M/C_M}\right] = \text{Constant} + \frac{\lambda s}{[*]}\log\left[\frac{P_A/C_A}{P_M/C_M}\right] - \frac{[\lambda(1-s)\beta\alpha^{-1} + \lambda s]}{[*]}\log\left[\frac{W_M}{P_M}\right] + \frac{\lambda\alpha^{-1}}{[*]}\log L$$

where $[(1-s)\alpha^{-1} + \lambda s] = [*] > 0$, and s is the share of the total labor force in agriculture. In addition, we have introduced the cost of living deflators for farm, C_A, and city, C_M, so that the real wage ratio now appears as the dependent variable. Note also that the urban unemployment rate is not present in this reduced form equation, but it can be derived simply enough from equation [4] once the wage gap is estimated from [6].

The Corden-Findlay-Todaro diagram in Figure 2 is consistent with equation [6], as it should be. A boom in agriculture's terms of trade shifts the AA' curve to the right in Figure 2, thus diminishing the wage gap and urban unemployment. Similarly, a rise in P_A in equation [6] also raises the wage ratio on the left hand side (thus diminishing the wage gap). A rise in the nominal nonfarm wage -- taken here to be determined by exogenous institutional forces just as Todaro argued -- raises the farm wage in Figure 2, but it also increases the wage gap and creates urban unemployment. Similarly, a rise in w_M in equation [6] lowers the wage ratio, increases the wage gap, and creates more urban unemployment. Although it is not shown in Figure 2, an immigrant-augmented labor force widens the base of the diagram yielding an increase in the wage gap. Similarly, a rise in L in equation [6] also lowers the wage ratio, raises the wage gap, and adds to urban unemployment.

The problem with this model is that it assumes -- following Todaro -- instantaneous migration adjustment, and we have already seen that the assumption is a poor one for the five decades following 1890. A simple way to introduce dynamics into the model is to replace equation [4] by the expression

$$[4'] \qquad \frac{L_A}{L_A(-1)} = \left[\frac{W_A/C_A}{(W_M/C_M)\epsilon(1 - U)^{\lambda}}\right]^{m}\left[\frac{L_{A(-1)}}{L_{A(-2)}}\right]^{\mu}$$

where m and μ are simply the speed of adjustment parameters describing migrant response to the Todaro-adjusted wage ratio. Expression [4'] implies that the shortrun migration elasticity is m, while the longrun elasticity is $m/(1-\mu)$. When we replace [4] with [4'] in the four equations above, we emerge with the reduced-form estimation equation (where we list on the RHS the abbreviation of the variables as they are reported in Table 3):

$$[6'] \qquad \log\left[\frac{W_A/C_A}{W_M/C_M}\right] = \text{Constant} + \frac{[\lambda s + (1-s)m^{-1}]}{[*]'} \log\left[\frac{P_A/C_A}{P_M/C_M}\right] \qquad \text{LTOTC}$$

$$- \frac{[(1-s)m^{-1}] + \lambda(1-s)\beta\alpha^{-1} + \lambda s]}{[*]'} \log\left[\frac{W_M}{P_M}\right] \qquad \text{LRWM}$$

$$+ \frac{\lambda\alpha^{-1}}{[*]'} \log L + \frac{[(1-s)m^{-1}]}{[*]'} \log\left[\frac{W_A(-1)}{P_A(-1)}\right] \qquad \text{LL, LWPA1}$$

$$+ \frac{[\mu(1-s)m^{-1}]}{[*]'} \log \left[\frac{W_A(-1)/P_A(-1)}{W_A(-2)/P_A(-2)}\right] \qquad \text{DLWPA1}$$

where now $[*]' = (1-s)m^{-1} - (1-s)\alpha^{-1} + \lambda s > 0$.
Note that when $m^{-1} = 0$, and thus when we have complete mobility, [6'] collapses into [6].

The estimates of equation [6'] are reported in Table 3. The results are quite successful. The estimated coefficients are of the correct sign: an expansion in the labor force (LL) serves to lower the wage ratio and to raise the wage gap (and to augment the urban unemployment rate); a boom in agriculture's terms of trade (LTOTC) serves to raise the wage ratio; and an increase in the nonfarm wage (LRWM) serves to lower the wage ratio. Furthermore, the distributed lag variables suggest, as before, that migrant responses to labor market shocks during the five decades were sluggish. With the exception of LL, the t-statistics are everywhere favorable, and the same is true of the adjusted R^2 and the DW-statistic. In short, we seem to have captured the central forces driving the wage gap from the early 1890s to the eve of World War II.

The predicted (from longrun estimated parameters) and actual wage ratio are plotted in Figure 4. The model seems to perform well in all epochs. It captures the collapse in the wage ratio during the depression of the mid 1890s, the modest rise in the ratio up to World War I, the sharp postwar collapse, and the continued erosion in the ratio across the twenties and thirties. Any evidence of regime switch in U.S. labor markets has now disappeared: those dramatic movements in the wage gap seem to be adequately accounted for by the magnitude of the labor market shocks and migrant sluggishness in responding to them.

What we'd like to learn now is which labor market shocks were doing most of the work. Was it terms of trade shocks emanating from conditions in world markets, as argued by Ahearn, Parsons, Warren and Pearson? Was it labor supply shocks generated by foreign immigration, favored by Brinley Thomas (1972), and stressed by Sir Arthur Lewis and other "pessimistic" development economists? Was it institutional forces manipulating the industrial wage, a premise which motivated the Todaro model in the first place, and one with which many macroeconomists might be comfortable? Was it always the same labor market shocks doing all the work, or did the driving forces vary across the epochs 1891-1896, 1896-1915, and 1915-1940?

Table 4 supplies the answers. For starters, labor force growth always served to lower the wage ratio, _ceteris paribus_. Indeed, had the immigrant-induced labor force expansion during the pre-World War I decades not been so rapid, the actual rise in the farm/nonfarm wage ratio would have been more impressive. This result may appear to be counterintuitive. Didn't the influx of immigrants into American cities serve to lower the urban wage and thus to raise the wage ratio and diminish the wage gap? Not in the Todaro model: here the nonfarm wage is fixed, so a glut of immigrants tends to increase urban unemployment, to discourage potential farm emigrants, to lower the flexible farm wage, and thus to reduce the wage ratio. Furthermore, the terms of trade has nowhere near the impact which the traditional literature assigns to it. True, the collapse in the farm terms of trade in the early 1890s and the interwar decades does lower the wage ratio, and the boom between

1896 and World War I does just the opposite, but these terms of trade shocks account for only a fifth of the combined impact of all three variables during the slump to 1896, and the figure is far smaller for the other periods. And in spite of all that has been said about the collapse of farm prices after World War I, terms of trade changes account for only 6 percent of the actual fall in the real wage ratio following 1915 and 1940.

The major force at work driving the wage gap appears to have been real wages in nonfarm employment. The sharp rise in the nonfarm real wage down to 1896 accounts for most of the fall in the wage ratio, its puzzling fall between 1896 and 1915 accounts for most of the improvement in the wage ratio over the same period, and the near doubling in the nonfarm real wage between 1915 and 1940 accounts for most of the fall in the wage ratio during the twenties and thirties. Todaro would have predicted as much. Indeed, his model was constructed to assess the impact of precisely such events.

VI. THE DUAL: LOOKING AT FARM EMIGRATION, 1920-1941

Thus far we have used the Todaro model to explain U.S. experience with wage gaps over the half century after 1890. However, Todaro's structural equation on wage gaps can be easily restated in terms of migration behavior, and it can also be embeded in a "partial" general equilibrium model of migration that allows farm and nonfarm labor markets to interact. The exercise would certainly fit well into the historiography of the interwar period which dwells at length on farm emigration during a period of powerful terms of trade shocks and extraordinary levels of urban unemployment during the Great Depression. Between 1920 and 1941, the farm population fell by 1.6 million and net farm emigration averaged 549,000 per year. While those farm emigration figures are impressive, they were not enough to eliminate or even reduce the wage gap between farm and city (Figures 3 and 4). In addition, and as Figure 6 indicates, emigration was hardly stable over the two decades. It was very high in the early and mid twenties, but fell steadily from a peak in 1922 to a trough a decade later. Indeed, there was net farm <u>immigration</u> in both 1931 and 1932. Following the trough of the Great Depression, farm emigration surged to World War II and in 1941 it was higher than at any time during the interwar period. What explains the instability? Can the Todaro model account for these farm emigration patterns with the same effectiveness that it has been found to account for wage gaps? It ought to since farm emigration is simply the dual of wage gaps in the Todaro model.

As we pointed out above, Todaro's structural equation on wage gaps can be restated in terms of migration behavior itself, yielding:

$$[7] \quad MIG = f + g_1 LRWR + g_2 LIU + g_3 MIG1 + e$$

where MIG is the net farm emigration rate, that is, annual net farm emigration divided by the agricultural population. The dependent variable in [7] has two limitations: first, it measures population migration rather than labor migration; and second, the USDA supplies the farm emigration estimates only starting in 1920. In spite of these data limitations, equation [7] still offers another test of Todaro's key structural equation on migration behavior.

The results are reported in Table 5. Once again, the Todaro hypothesis fares well. A rise in the farm real wage relative to the nonfarm real wage tends to choke off emigration, and the t-statistic on LRWR is large. A rise in the urban employment rate tends to foster emigration, and, once again, the t-statistic on LIU is large. Furthermore, the coefficients on LRWR and LIU are of equal and opposite sign, just as Todaro would have predicted. Interestingly enough, migrants in the interwar period appear to have been responsive to current labor market signals alone, since the coefficient on lagged migration is very small and insignificant. That result may be explained in part by the fact that the migration data is reported from April in the current year to April in the next. In any case, the farm emigration elasticity with respect to labor market signals was very low, about 0.09, suggesting once again an explanation for those big Hagen distortions that Figure 3 documented for the interwar years.

As Appendix A shows, we can also derive a reduced-form equation for farm emigration which is an approximate dual of the reduced-form real wage ratio equation [6']. The exercise is certainly worth the effort since it can be used to assess the role of "push" and "pull" in the two labor markets in contributing to the farm exodus during the turbulent interwar years. The estimation equation is:

[8]
$$\frac{M}{Pop} = MIG = \text{Constant} - m\log\left[\frac{P_A/C_A}{P_M/C_M}\right] + m(\lambda\beta+1)\log\left[\frac{W_M}{P_M}\right] \qquad \text{TOTC, RWM}$$

$$- \frac{m\lambda}{(1-s)}\log L + m[\lambda\alpha s(1-s)^{-1} - 1]\log\left[\frac{W_A}{P_A}\right] \qquad \text{L, WPA}$$

where, as before, TOTC is the farm terms of trade adjusted by relative cost of living differentials, RWM is the exogenous nonfarm real wage facing producers, WPA is the real wage facing farmers, and L is the total labor force. Our expectation, of course, is that an improvement in the farm terms of trade and the farm real wage should both choke off emigration. Based on the analysis in the previous section, a rise in the labor force nationwide should also choke off emigration: to repeat, given the real nonfarm wage, more laborers implies more urban unemployment and thus less farm emigration. The sign on the nonfarm real wage, however, is ambiguous, hinging as it does on the elasticity of labor demand in the city. This argument can be seen clearly in Figure 5. The the inelastic labor demand curve MM' in Figure 5A (recall that the qq curve has unitary elasticity) implies a reduction in agricultural employment in response to a rise in W_M and thus a rise in farm emigration: that is, the rise in the W_M offsets the more modest rise in urban unemployment, implying a rise in the expected real wage in the city. The elastic labor demand curve MM' in Figure 5B implies an increase in agricultural employment in response to a rise in W_M and thus a fall in farm emigration: that is, the rise in W_M is offset by the more dramatic rise in urban unemployment, implying a fall in the expected real wage in the city.

Table 6 shows that the reduced-form version of the Todaro model performs very well when applied to emigration. We should note, however, that RWA is jointly dependent with MIG since the latter is a function of current and lagged agricultural employment. We must correct, therefore, for the possibility for a simultaneous equations bias. To do so, we instrumented current LRWA by using lagged LRWA. The results are very attractive. Every t-statistic is large and the signs on the farm terms of trade, the labor force, and the real farm wage all conform with expectations. The sign on LRWM turns out to be positive, implying that labor demand in the nonfarm sector was inelastic during the interwar years, a result which is certainly consistent with the other stylized facts.

The actual and the predicted farm emigration rates are plotted in Figure 6. The model captures the fall in the farm emigration rate from the early twenties to the depths of the Depression and the striking resurgence thereafter. What, then, accounts for those trends? In the previous section we found it was real wage shocks in the [illegible] ector that were doing most of the work in driving the wage gap. [illegible] the same for farm emigration? Table 7 supplies the answers. [illegible] steady decline in farm emigration rates from their high in 1[illegible] ow in 1932 can be attributed, according to the model [illegible] the rise in the nationwide labor force and to the recovery [illegible] agriculture. The surge in farm emigration rates from 1932 to 1941, on the other hand, is explained almost entirely by the sharp rise in real nonfarm wages (a result we also found in Section V), although the erosion in real farm wages adds to this influence.

The reader might wonder whether our results would be affected by New Deal policies, particularly wage setting under the NRA and the expansion of relief programs. The residuals from the migration equation (Figure 6) offer no evidence of systematic deviations in the second half of the 1930s, and when we entered a dummy variable for 1933-1941 it did not take on a significant coefficient. This is not as surprising as it seems when we consider the likely effects of New Deal Programs. With regard to NRA wage setting, its effects are already captured in the real wage ratio. With regard to relief, the effects are more difficult to judge. It has been argued that the inclusion of relief workers in the unemployment count leads to a substantial exaggeration of the total (Darby, 1976). In terms of the Todaro model, the deterrent effect of high urban unemployment on farm-city migration would be attenuated in the presence of city doles or work relief. However, it should be remembered that much of the emergency relief took place in rural areas, and it has been estimated that perhaps a third of outdoor relief expenditures went to assist rural families (Geddes, 1937, p. 4[illegible]). Hence, rural and urban relief programs could have had opposite effects on rural-urban migration though it is not yet possible to say whether these were approximately offsetting.

VII. LABOR MARKET DISTORTIONS, THE TODARO MODEL AND MACROECONOMIC IMPLICATIONS

As far as we know, this paper represents the first attempt to address quantitatively the puzzle of the American wage gap between farm and factory during the turbulent years from 1890 to 1941. Why were the gaps so large and why did they vary so much over these five decades? More to the point, can they be explained by models whose intellectual tradition originates with American experience but which have until now been used principally to explain wage gaps in the Third World? If we were able to account fully for in-kind payments, seasonal underemployment in agriculture, as well as components of compensating differentials, the wage gap, or what we call "true Hagen distortions", could possibly, on average, disappear. Yet, this unlikely event would hardly help explain why the wage gap varied so much over time, and why it was so large in the 1930s.

When Todaro's structural equation is explored in Section IV, the results suggest that urban unemployment did indeed drive the wage gap. But the adjustment lags are long; in fact, the average lag is about four years. When Todaro's structural equation is embedded in a "partial" general disequilibrium model, can more fundamental forces like the intersectoral terms of trade, the urban real wage, and total labor supplies be shown to play an important role? In Section V we show that they can, provided we take account of the sluggish response of migration to these shocks. Yet it is important to stress that it was not sluggish migration behavior alone which led to volatility in the wage gap. As Figure 4 shows, the underlying shocks would have led to roughly the same rise in the wage gap across the 1920s and 1930s even had migration fully adjusted each year. That is, fundamental shocks to the economy served to drive the urban unemployment rate, and thus the wage gap, just as Todaro argued.

Were contemporary interwar observers and early postwar writers right in the emphasis they gave to terms of trade shocks and elastic intrasectoral labor supplies? In part, they were. Our model suggests that the declining relative price of farm products drove down the farm wage relative to the factory wage during the Great Depression, over the longer period from 1915 to 1940, and during the early 1890s. Growth in labor supplies exacerbated these trends. Contemporary observers like Ducoff, Parsons, Schultz, and Weatherford also understood the importance of urban unemployment in conditioning farm emigration, but they failed to understand what drove the urban unemployment rate itself -- urban real wage shocks. Above all, it was these shocks which opened up the wage gap so wide in the 1920s and 1930s, both directly, and indirectly through their impact on labor demand and unemployment in the cities.

A skeptic might offer an alternative explanation for the Todaro-like relationship in the data. Given that urban nominal wages are more sticky than rural nominal wages, and given that demand shocks are correlated across sectors, then the skeptic would expect a more severe decline in the rural wage and a more pronounced rise in urban unemployment in a slump. This prediction would hold even if the two sectors were completely segmented. To anticipate the skeptic, we estimated our migration equation in Section VI. The results reinforce the view that the two sectors were linked by migration, and that both the wage gap and urban unemployment mattered precisely as Todaro would have predicted. However, while long lags in adjustment were absent in the interwar period, we found that the migration response was very inelastic, helping account for those large "true Hagen distortions".

What are the macroeconomic implications of our results? Some contemporaries saw the rural sector as an "industrial labor reserve", such that the urban sector drew on rural labor supplies when times were good and sent them back in a slump. They emphasized that gross migration flows went in both directions and that a flexible wage in agriculture helped absorb labor during depressions. Using our model of migration, we can assess the strength of such effects. Suppose we ask the question: what would have happened to unemployment had the farm wage been inflexible downwards and had it not collapsed relative to city wages during the 1930s? The urban unemployment rate would have been higher, of course, since agriculture would not have absorbed any of the urban unemployed. But how much higher hinges on two factors: the size of the agricultural sector and the response of intersectoral migration to Todaro's expected real wage differentials. Drawing on our estimates in Table 5 and the argument in Appendix A, we can estimate the counterfactual unemployment rate in the 1930s had the real wage ratio between farm and factory remained constant at its 1931 value, 0.6. The results are:

	Actual U	Counterfactual U
1931-1935	26.90	30.48
1936-1940	19.79	29.45
Difference	7.11	1.03

These results suggest that employment recovery from the Great Depression was aided by the fall in the farm wage, and the effect was very large. There is reason to expect, furthermore, that even more powerful results would obtain for the 1890s or the 1870s when the agricultural sector was far bigger. The larger the agricultural sector, the greater would be the observed stability in the (urban) unemployment rate over the business cycle given identical shocks to the economy overall.

This conclusion has relevance, we believe, to recent efforts to answer the question: Has the American economy become more stable over the past century? It argues that such comparisons had best be made with a macroeconomic model which pays attention to two sectors, not just one. Multisectoral models of macroinstability are needed to truly assess such questions, and we urge macroeconomists to think in those terms in the future.

FOOTNOTES

This paper has been partially supported by a grant from the National Science Foundation, SES-84-08210. The authors gratefully acknowledge the research assistance of Carlos Ramirez. A modified version of this paper is to be presented at the Second World Congress of Cliometrics, Santander, Spain (June 24-27, 1989).

[1] This and the next three paragraphs are taken from Williamson (forthcoming, Chp. 5, pp. 2-4).

[2] The qq' curve is a rectangular hyperbola with unitary elasticity. The elasticity of the labor demand curve MM' is assumed to be less than unity in Figure 2, an assumption that is commonly invoked by development economists, and confirmed in Section VI below.

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Table 1. Testing the Simple Todaro Model of Wage Gaps: 1891-1941

Dependent variable is LRWR = Log Real Wage Ratio, Farm to Nonfarm			
Regressor	Coefficient	Standard Error	T-Ratio
C	-.0412	.0237	-1.7384
LIU	.2034	.0636	3.1991
LRWR1	.8136	.0644	12.6351
D	-.0507	.0160	-3.1758

R-Squared	.9179	F-statistic F(3, 47)	175.2579
R-Bar-Squared	.9127	S.E. of Regression	.0426
Residual Sum of Squares	.0851	Mean of Dependent Variable	-.4750
S.D. of Dependent Variable	.1441	Maximum of Log-likelihood	90.7119
DW-statistic	2.4008		

Table 2. Testing the Simple Todaro Model of Wage Gaps in the Long Run: 1891-1941

Coefficient on	1891-1915	1916-1941
Constant	.8017	.6108
(1-U)	1.0912	1.0912

Note: Derived from Table 1.

Table 3. Testing a Disequilibrium Version of the Todaro Model of Wage Gaps: 1892-1941

Dependent variable is LRWR

Regressor	Coefficient	Standard Error	T-Ratio
C	.1439	.7408	.1942
LL	-.0911	.0584	-1.5610
LTOTC	.6451	.1234	5.2300
LRWM	-.6514	.0806	-8.0837
LWPA1	.3675	.1037	3.5450
DLWPA1	.2503	.1191	2.1019

R-Squared	.8169	F-Statistic F(5,44)	39.2676
R-Bar-Squared	.7961	S.E. of Regression	.0654
Residual Sum of Squares	.1882	Mean of Dependent Variable	-.4769
S.D. of Dependent Variable	.1448	Maximum of Log-likelihood	68.6164
DW-statistic	1.6157		

Table 4. Decomposing the Sources of Changes in the Real Wage Ratio: Three Epochs

Item	1891-1896	1896-1915	1915-1940
Change in Actual log RWR	-.0405	.0566	-.4462
Contribution of Change in:			
LL	-.0166	-.0599	-.0485
LTOTC	-.0202	.0175	-.0280
LRWM	-.0611	.0487	-.2804
Residual	.0574	.0503	-.0893

Note: Each year is centered on a three-year average, and the "contributions" are calculated using longrun estimated parameters.

Table 5. Testing the Simple Todaro Model of Migration: 1921-1941

Dependent variable is MIG = Net Farm Emigration Rate

Regressor	Coefficient	Standard Error	T-Ratio
C	-.0184	.0092	-1.9996
LRWR	-.0859	.0216	-3.9778
LIU	.0876	.0301	2.9123
MIG1	.0280	.2585	.1084

R-Squared	.6411	F-statistic F(3, 17)	10.1214
R-Bar-Squared	.5777	S.E. of Regression	.0094
Residual Sum of Squares	.0015	Mean of Dependent Variable	.0186
S.D. of Dependent Variable	.0144	Maximum of Log-likelihood	70.5128
DW-statistic	1.5072		

Table 6. Testing the Reduced Form Version of the Todaro Model of Migration Using Instrumental Variables: 1921-1941

Dependent variable is MIG = Net Farm Emigration Rate
Instrumental Variable Estimation

Regressor	Coefficient	Standard Error	T-Ratio
C	2.2087	.7752	2.8492
LTOTC	-.1181	.0492	-2.3987
LRWM	.1877	.0564	3.3265
LRWA	-.1315	.0508	-2.5894
LL	-.2030	.0729	-2.7830

R-Squared	.7105	F-statistic F(4, 16)	9.8155
R-Bar-Squared	.6381	S.E. of Regression	.0087
Residual Sum of Squares	.0012	Mean of Dependent Variable	.0186
S.D. of Dependent Variable	.0144		
DW-statistic	1.8571		

Table 7. Decomposing the Sources of Farm Emigration During Two Interwar Epochs

Item	1921-1932	1932-1941
Change in Actual MIG	-.0369	.0720
Contribution of Change in:		
LTOTC	.0027	-.0175
LRWM	.0085	.0768
LRWA	-.0158	.0131
LL	-.0359	-.0223
Residual:	.0036	.0219

Note: Calculated from Table 6.

APPENDIX A. DERIVATION OF THE BASIC REDUCED FORM MODELS

The basic structure consists of the four equations [2], [3], [4'], and [5] in the text:

[A1] $$L_M = B\left[\frac{W_M}{P_M}\right]^{\beta}$$

[A2] $$L_A = A\left[\frac{W_A}{P_A}\right]^{\alpha}$$

[A3] $$\frac{L_A}{L_A(-1)} = \left[\frac{W_A/C_A}{(W_M/C_M)\epsilon(1 - U)^{\lambda}}\right]^{m}\left[\frac{L_A(-1)}{L_A(-2)}\right]^{\mu}$$

[A4] $$(1 - U) = \frac{L_M}{(L - L_A)}$$

Substituting [A4] into [A3], taking logs and using the approximation $\log(L - L_A) = \frac{1}{1 - s}\log L - \frac{s}{1 - s}\log L_A$ (where s is the share of the total labor force in agriculture), we get:

[A5] $$\log\left[\frac{L_A}{L_A(-1)}\right] = m\log\left[\frac{W_A/C_A}{W_M/C_M}\right] - m\log\epsilon - m\lambda\log L_M + \frac{m\lambda}{1 - s}\log L - \frac{m\lambda s}{1 - s}\log L_A + \mu\log\left[\frac{L_A(-1)}{L_A(-2)}\right]$$

Substituting the labor demands from [A1] and [A2]

$$[A6] \quad \alpha \log\left[\frac{W_A/P_A}{W_A(-1)/P_A(-1)}\right] = m\log\left[\frac{W_A/C_A}{W_M/C_M}\right] - m\log\epsilon - m\lambda\log B - m\lambda\beta\log\left[\frac{W_M}{P_M}\right]$$

$$+ \frac{m\lambda}{1-s}\log L - \frac{m\lambda s}{1-s}\log A - \frac{m\lambda s\alpha}{1-s}\log\left[\frac{W_A}{P_A}\right]$$

$$+ \mu\alpha\log\left[\frac{W_A(-1)/P_A(-1)}{W_A(-2)/P_A(-2)}\right]$$

Gathering terms and leaving the market clearing wage, W_A, on the LHS

$$[A7] \quad \log W_A = \frac{[(1-s)m^{-1}]}{[*]}\log\left[\frac{W_A(-1)}{P_A(-1)}\right] + \frac{[(1-s)\alpha^{-1}]}{[*]}\log\left[\frac{1/C_A}{W_M/C_M}\right]$$

$$- \frac{[(1-s)\alpha^{-1}]}{[*]}\log\epsilon - \frac{[\lambda(1-s)\alpha^{-1}]}{[*]}\log B$$

$$- \frac{[\lambda(1-s)\beta\alpha^{-1}]}{[*]}\log\left[\frac{W_M}{P_M}\right] + \frac{\lambda\alpha^{-1}}{[*]}\log L$$

$$- \frac{\lambda s\alpha^{-1}}{[*]}\log A + \frac{[(1-s)m^{-1} + s\lambda]}{[*]}\log P_A$$

$$+ \frac{[\mu(1-s)m^{-1}]}{[*]}\log\left[\frac{W_A(-1)/P_A(-1)}{W_A(-2)/P_A(-2)}\right]$$

where $[*] = [(1-s)m^{-1} - (s-1)\alpha^{-1} + \lambda s]$ which is positive (assuming the labor demand elasticity, $\alpha < 0$).

Multiplying both sides by $\frac{1/C_A}{W_M/C_M}$ and rearranging terms yields:

$$[A8] \qquad \log\left[\frac{W_A/C_A}{W_M/C_M}\right] = \text{Constant} + \frac{[\lambda s + (1-s)m^{-1}]}{[*]}\log\left[\frac{P_A/C_A}{P_M/C_M}\right],$$

$$- \frac{[[(1-s)m^{-1}] + \lambda(1-s)\beta\alpha^{-1} + \lambda s]}{[*]}\log\left[\frac{W_M}{P_M}\right]$$

$$+ \frac{\lambda\alpha^{-1}}{[*]}\log L + \frac{[(1-s)m^{-1}]}{[*]}\log\left[\frac{W_A(-1)}{P_A(-1)}\right]$$

$$+ \frac{[\mu(1-s)m^{-1}]}{[*]}\log\left[\frac{W_A(-1)/P_A(-1)}{W_A(-2)/P_A(-2)}\right]$$

where $\text{Constant} = - \frac{[(1-s)\alpha^{-1}]}{[*]}\log\epsilon - \frac{[\lambda(1-s)\alpha^{-1}]}{[*]}\log B - \frac{\lambda s\ \alpha^{-1}}{[*]}\log A$

This is the equation we estimate in Section V of the paper and which is reported in the text as equation [6′]. If we restrict the dynamics of the model and assume complete mobility, we have $m^{-1} = 0$ and [A8] reduces to:

$$[A9] \qquad \log\left[\frac{W_A/C_A}{\text{[illegible]}}\right] = \text{Constant}' + \frac{\lambda s}{[*]'}\log\left[\frac{P_A/C_A}{P_M/C_M}\right]$$

$$\text{[illegible]}\frac{[\lambda(1-s)\beta\alpha^{-1} + \lambda s]}{[*]'}\log\left[\frac{W_M}{P_M}\right] + \frac{\lambda\alpha^{-1}}{[*]'}\log L$$

where $[*]' = [-(s-1)\alpha^{-1} + \lambda s$ [illegible] is is equation (6) in the text. This also provides the long run sol[illegible] quation [A8] which we use to plot the long run equilibrium wage g[illegible] re 4.

For the migration equations [illegible] on VI, we use expression [A5] and write out-migration from agricultur[illegible]

$$\frac{M}{Pop} = -\log\left[\frac{L_A}{L_A(-1)}\right] - n$$

where M is the net flow of off-farm migration, Pop is the farm population, and n represents the natural increase of the farm labor force. In the light of our empirical results we drop the lagged dependent variable in migration, setting $\mu = 0$. Substituting the expression for migration and the labor demands into [A5] yields:

[A10]
$$\frac{M}{Pop} = n - m\log\left[\frac{W_A/C_A}{W_M/C_M}\right] + m\log\epsilon + m\lambda\beta \log\left[\frac{W_M}{P_M}\right]$$

$$+ m\lambda\log B - \frac{m\lambda}{(1-s)}\log L + \frac{[m\lambda s\alpha]}{(1-s)}\log\left[\frac{W_A}{P_A}\right]$$

$$+ \frac{m\lambda s}{(1-s)}\log A$$

which can be rearranged to get:

[A11]
$$\frac{M}{Pop} = \text{Constant} - m\log\left[\frac{P_A/C_A}{P_M/C_M}\right] + m(\lambda\beta+1)\log\left[\frac{W_M}{P_M}\right]$$

$$- \frac{m\lambda}{(1-s)}\log L + m[\lambda\alpha s(1-s)^{-1} - 1]\log\left[\frac{W_A}{P_A}\right]$$

where $\text{Constant} = m\log\epsilon + m\lambda\log B + \frac{m\lambda s}{(1-s)}\log A$. This is the equation we estimate in Section VI.

Finally, it can be noted that substituting the labor demands into the expresssion for log(1-U) gives

$$[A12] \qquad \log(1-U) = \beta\log\left[\frac{W_M}{P_M}\right] - \frac{1}{1-s}\log L + \frac{s\alpha}{1-s}\log\left[\frac{W_A}{P_A}\right] + \log B + \frac{s}{1-s}\log A$$

which can be rearranged as

$$[A13] \qquad \log(1-U) = \frac{s\alpha}{1-s}\log\left[\frac{W_A/C_A}{W_M/C_M}\right] - \frac{s\alpha}{1-s}\log\left[\frac{P_A/C_A}{P_M/C_M}\right] + \frac{[s\alpha(1-s)^{-1]} + \beta]}{1-s}\log\left[\frac{W_M}{P_M}\right] - \frac{1}{1-s}\log L + \frac{s}{1-s}\log A + \log B$$

This is the equation we use in the last section to generate the counterfactual unemployment rates for deviations of $\left[\frac{W_A/C_A}{W_M/C_M}\right]$ from its actual value. The value of $\frac{s\alpha}{1-s}$ is taken from our estimate of [A11] which appears in Table 5 and from an estimate of the structural migration equation comparable with that in Table 5 but excluding the lagged dependent variable (to obtain the value of $m\lambda$).

APPENDIX B. TESTING THE SIMPLEST TODARO EQUILIBRIUM MODEL: LEBERGOTT VERSUS ROMER VERSUS WEIR

With the appearance of papers by Christina Romer (1986) and David Weir (1985), Stanley Lebergott's unemployment data have come under attack. It turns out that these competing estimates suggest different inferences about the instability of the American economy since 1890. Given that macrohistorians have placed such importance on the debate, it seemed wise to see whether choosing between them also has important implications for the success or failure of the Todaro model.

Based on the results reported in Table B.1, it may first appear that all three unemployment series generate quite similar regression results. The shortrun elasticity of the real wage ratio (RWR) on one minus the urban unemployment rate (1-U) is similar, ranging between 0.20 and 0.27, and the coefficient on the dummy variable (D) is also similar, ranging between -0.04 and -0.05. However, the longrun elasticities on (1-U) are quite different: the Lebergott results confirm the Todaro hypothesis with an elasticity of 1.0912; the Romer results are a little less attractive, 1.3569; and the Weir results are very unattractive, 2.0135.

Since the older Lebergott unemployment data are more consistent with the Todaro hypothesis, we use them in the remainder of the paper.

Table B.1. Testing the Simplest Todaro Equilibrium Model: Lebergott versus Romer versus Weir, 1891-1941

A. LEBERGOTT UNEMPLOYMENT DATA

Regressor	Coefficient		Standard Error	T-Ratio
C	-.0412		.0237	-1.7384
Log(1-U)	.2034		.0636	3.1991
Log RWR(-1)	.8136		.0644	12.6351
D	-.0507		.0160	-3.1758
R-Squared	.9179	F-statistic F(3, 47)		175.2579
R-Bar-Squared	.9127	S.E. of Regression		.0426
Residual Sum of Squares	.0851	Mean of Dependent Variable		-.4750
S.D. of Dependent Variable	.1441	Maximum of Log-likelihood		90.7119
DW-statistic	2.4008			

B. WEIR UNEMPLOYMENT DATA

Regressor	Coefficient		Standard Error	T-Ratio
C	-.0207		.0247	-.8357
Log(1-U)	.2692		.1039	2.5901
Log RWR(-1)	.8663		.0615	14.0774
D	-.0395		.0161	-2.4522
R-Squared	.9126	F-statistic F(3, 47)		163.4974
R-Bar Squared	.9070	S.E. of Regression		.0439
Residual Sum of Squares	.0907	Mean of Dependent Variable		-.4750
S.D. of Dependent Variable	.1441	Maximum of Log-likelihood		89.0907
DW-statistic	2.4731			

C. ROMER UNEMPLOYMENT DATA

Regressor	Coefficient		Standard Error	T-Ratio
C	-.0390		.0235	-1.6593
Log(1-U)	.2574		.0784	3.2833
Log RWR(-1)	-.8103		.0643	12.6081
D	-.0461		.0157	-2.9457
R-Squared	.9187	F-statistic F(3, 47)		177.0799
R-Bar-Squared	.9135	S.E. of Regression		.0424
Residual Sum of Squares	.0843	Mean of Dependent Variable		-.4750
S.D. of Dependent Variable	.1441	Maximum of Log-likelihood		90.9541
DW-statistic	2.4025			

Notes: Dependent variable is logRWR.
51 observations used for estimation from 1891 to 1941.

APPENDIX C. DATA SOURCES

Nominal Farm Wage(W_A): This is defined as the weekly wage rate without board and is derived as an average of monthly and daily rates, both adjusted to a weekly basis and weighted by 0.6 and 0.4 respectively. For 1890-1909, the series is taken from Douglas [1930, Table 62, p. 186]. For 1910-1941, the series is calculated from the Bureau of Agricultural Economics [1943, pp. 3-4].

Nominal Nonfarm Wage(W_M): This is defined as average weekly earnings of unskilled male workers in manufacturing. For 1921-1941, the series is taken from the National Industrial Conference Board figures reported in Historical Statistics [1975, D-841, p. 172]. For 1890-1920, the series is taken from Coombs [1926, Table 5, Series 2, p. 99].

Cost of Living Farm and Nonfarm(C_A, C_M): The benchmark year is 1941. Koffsky [1949, p. 170] estimates farm versus nonfarm cost of living differentials for that year, and these have been adjusted for rents by Alston and Hatton [1988, Table 5, p. 14]. This benchmark year is then extended back in time by using the farm and city cost of living time series 1890-1941 reported in Williamson and Lindert [1980, Table 5.12, p. 123].

Urban Unemployment Rate(U): The underlying data is taken from Lebergott [1964, Tables A-1, A-3, and A-15, pp. 510, 512, and 522]. The denominator is civilian minus farm labor force, where the latter was derived for 1890-1900 from a linear interpolation of the ratio of farm to civilian labor force. The same denominator is also applied to the Romer [1986, Table 9] and Weir [1985, Table 18] unemployment estimates. We assume that all unemployed are nonfarm, although farm seasonal employment was, of course, quite significant.

Terms of Trade(P_A,P_M): BLS prices of farm products are taken from Historical Statistics [1975, E-42, p. 200]. Manufactured commodity prices are taken from the same source [E-89, p. 203] and the BLS Handbook of Labor Statistics [1951, D-5, p. 118], linked on 1913-1915.

Farm Emigration Rate(MIG): Net emigration of farm population from current April 1 to next year's April 1, relative to farm population at current year's April 1, from Historical Statistics [1975, C-76 and C-78, p. 96].

Civilian Labor Force (L): Same source as urban unemployment rate above.

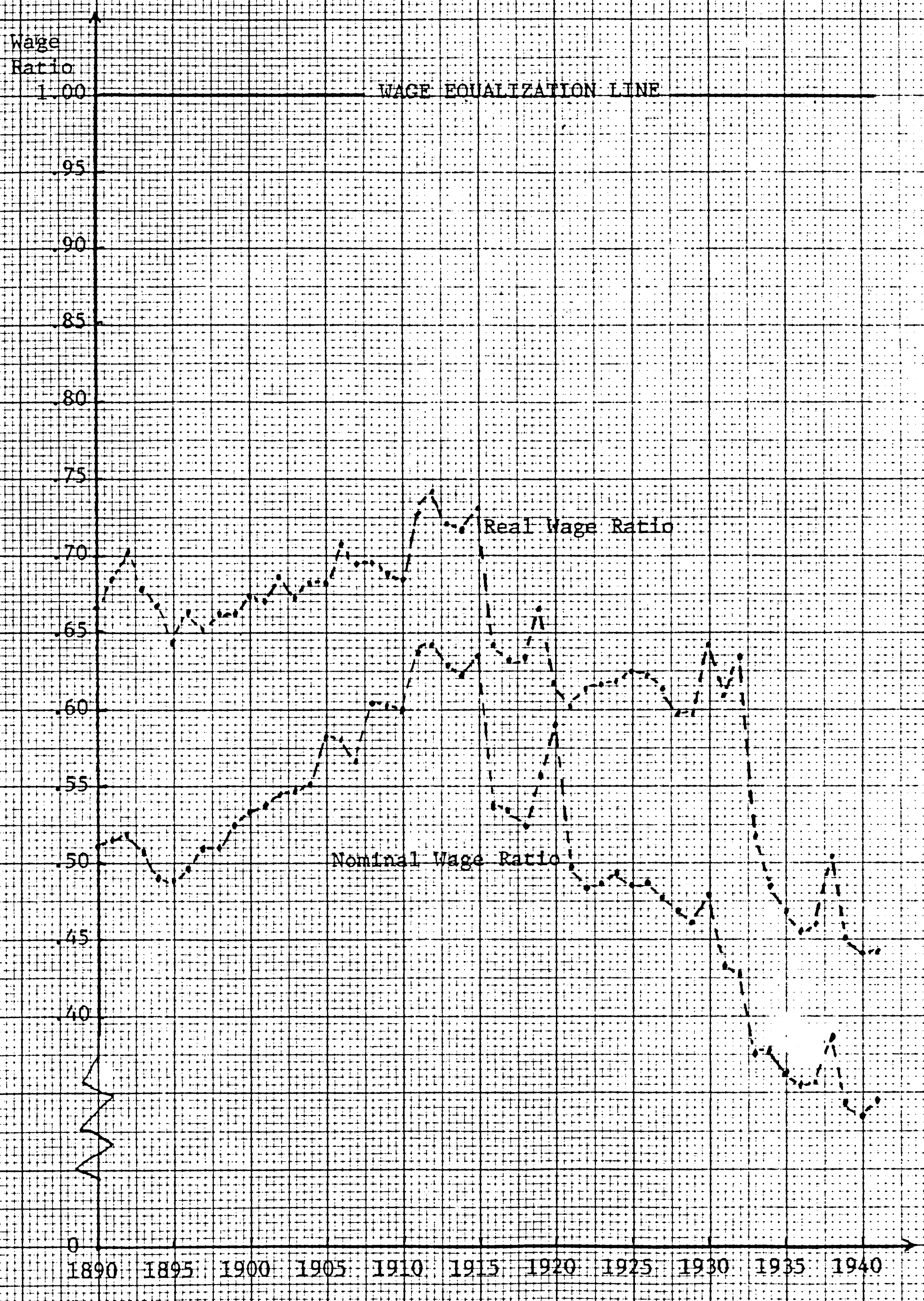

Figure 1. Real and Nominal Wage Ratio, Farm to Nonfarm: 1890-1941

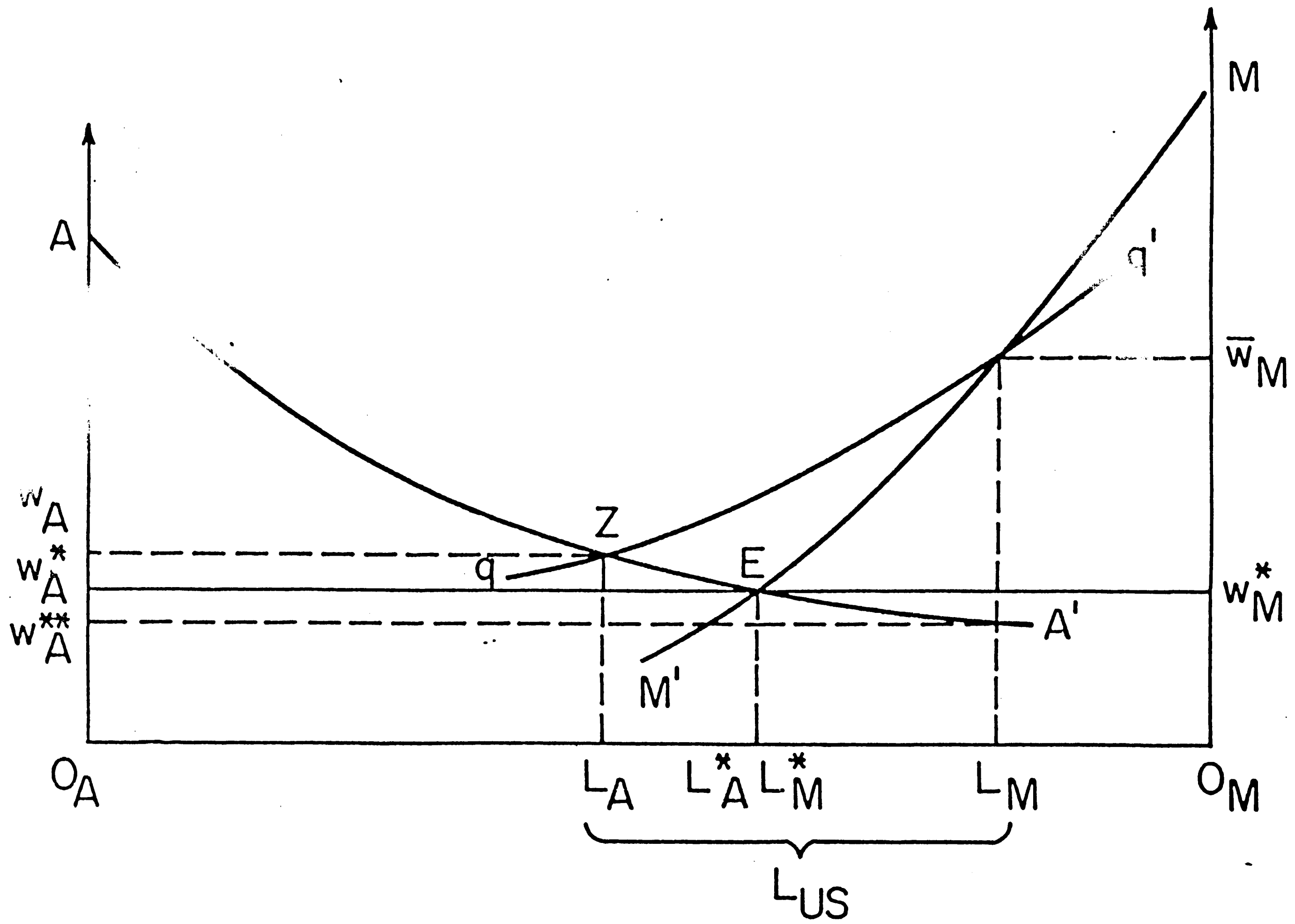

Figure 2. The Todaro Model According to Corden and Findlay

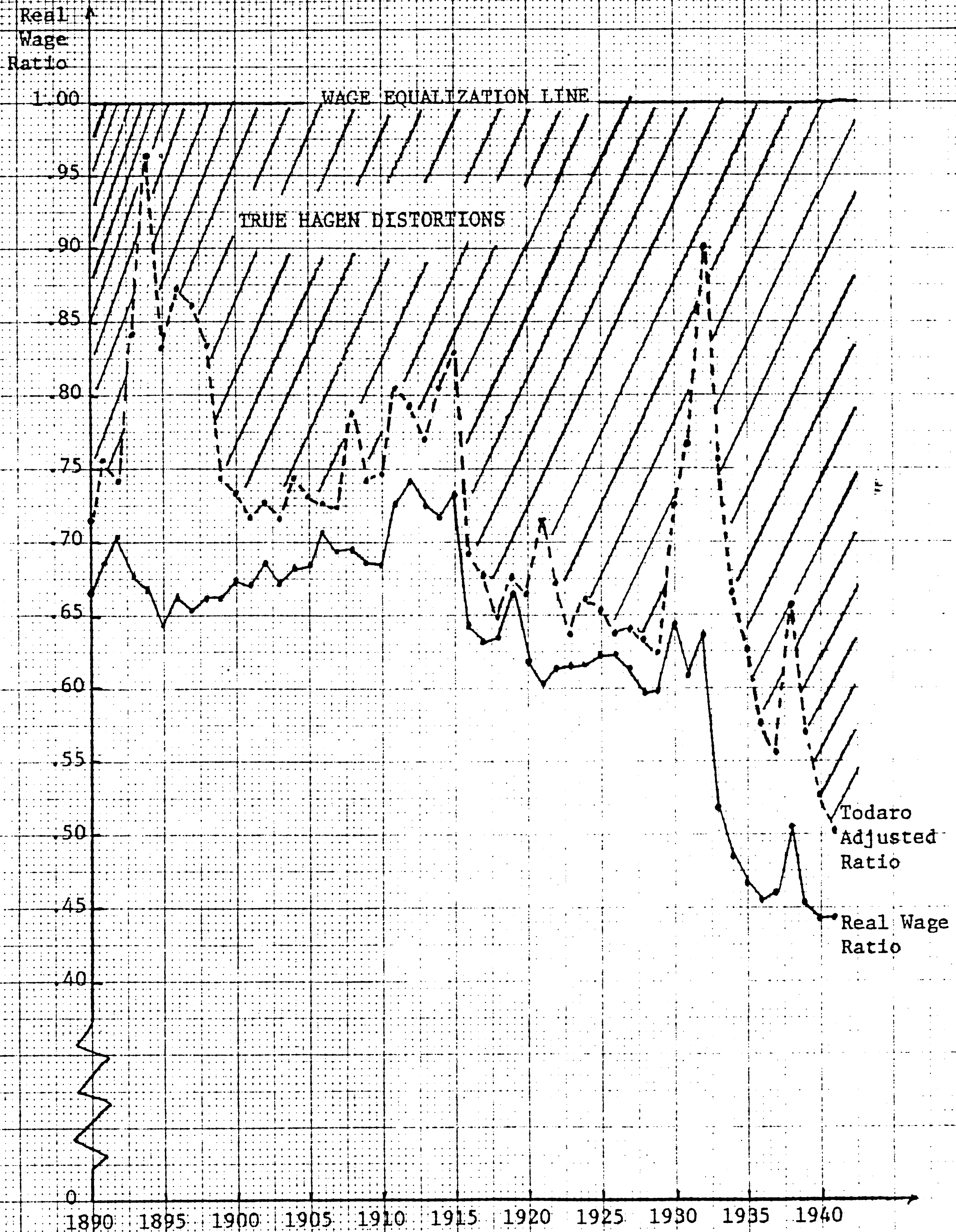

Figure 3. Real Wage Ratio, Todaro-Adjusted Real Wage Ratio and True Hagen Distortions: 1890-1941

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12-282
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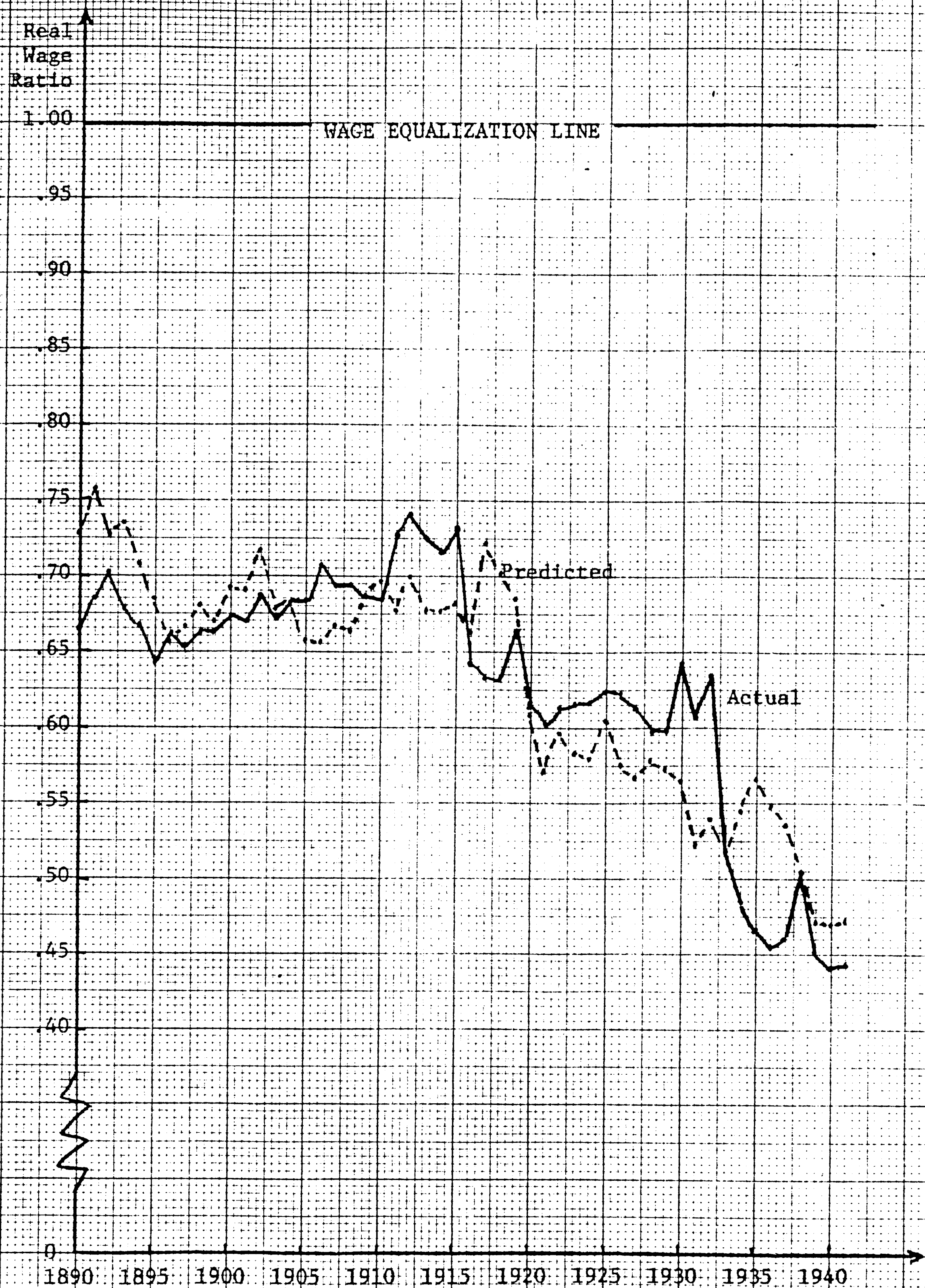
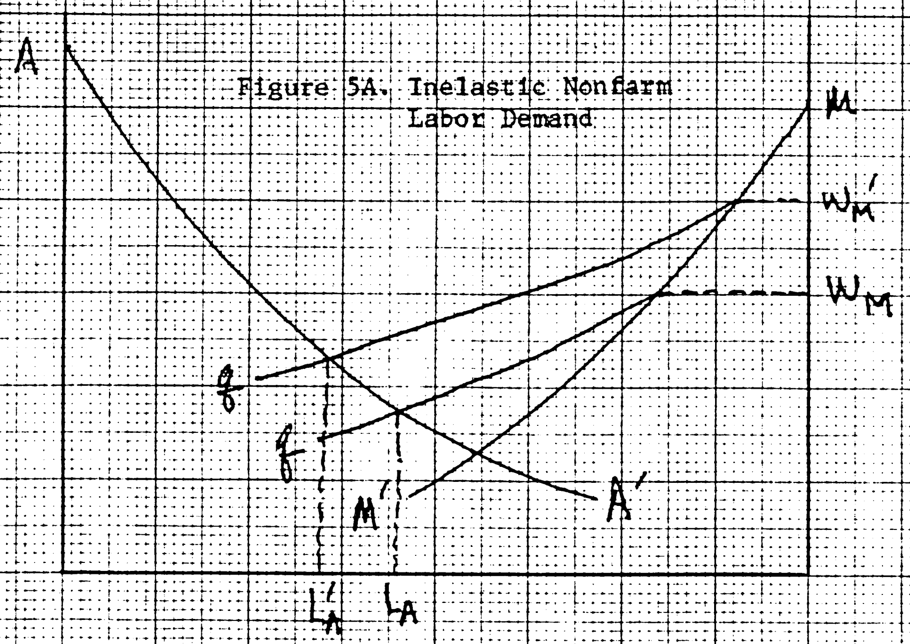


Figure 4. Actual and Predicted (Long Run) Real
Wage Ratio: 1890-1941

20 Squares to the Inch



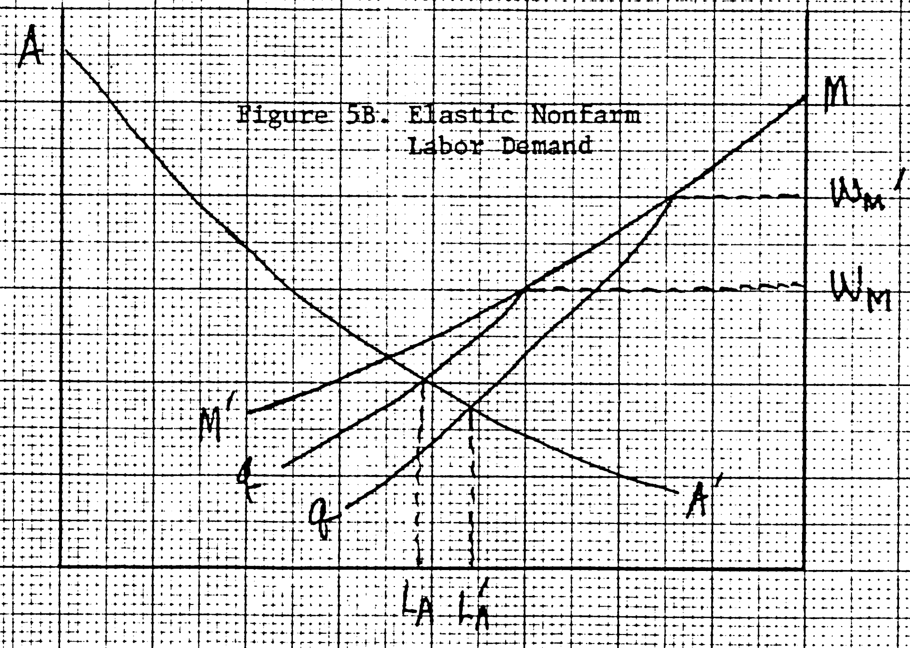
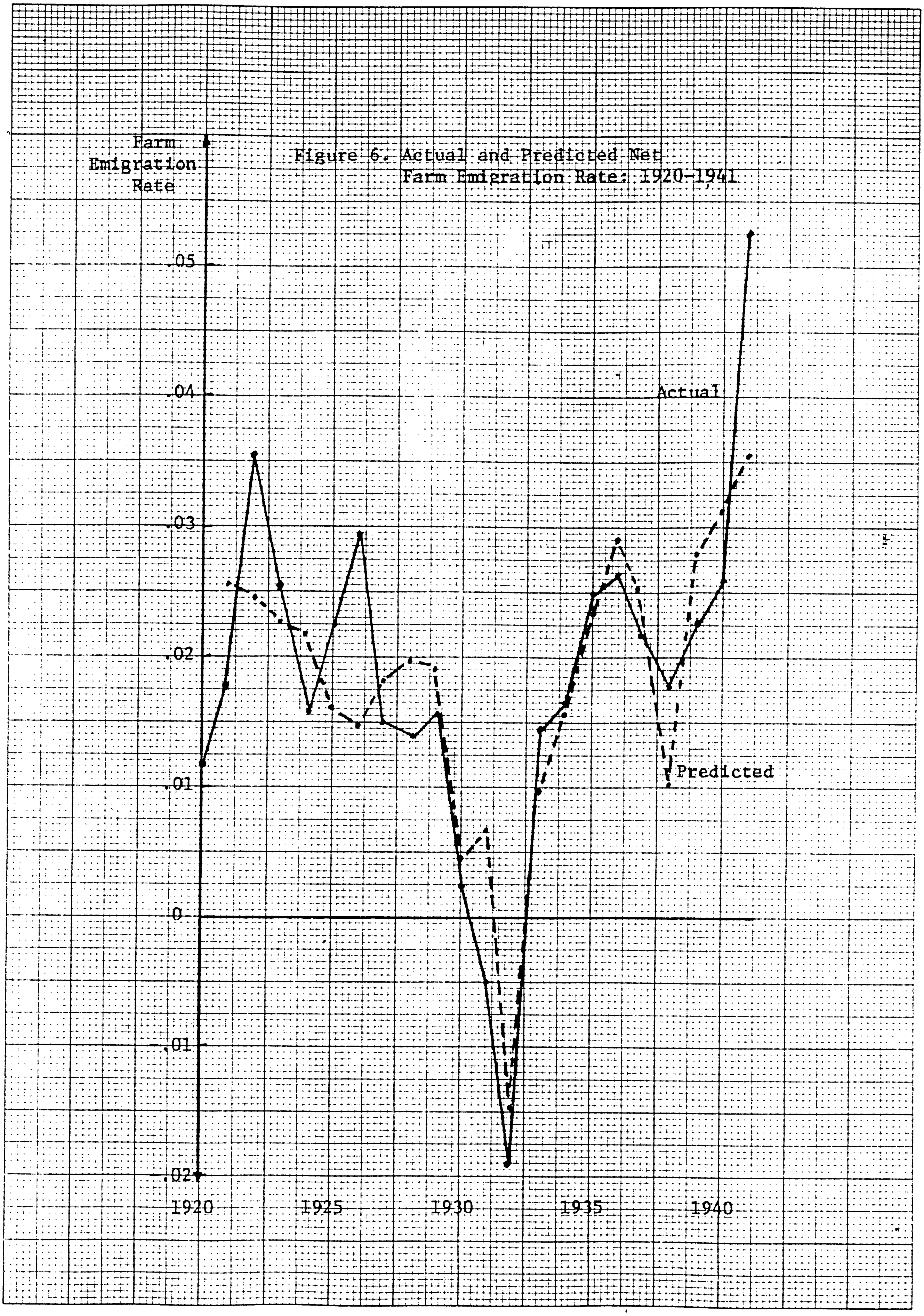


Figure 5. The Impact of Nonfarm Real Wages on Farm Emigration According to Todaro: The Role of Derived Labor Demand Elasticities in the Nonfarm Sector


Farm
Emigration
Rate
Figure 6. Actual and Predicted Net
Farm Emigration Rate: 1920-1941
.05
.04
.03
.02
.01
0
-.01
-.02
Actual
Predicted
1920
1925
1930
1935
1940

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