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The Old South's Stake in the Inter-Regional Movement of Slaves, 1850-1860

ONE of the many interesting questions raised in the recent literature on slavery in the United States is the effect on the Old South, the southeastern coastal and border states, of western land expansion and the induced western movement of slaves. The issue lies at the very heart of the "natural limits" hypothesis, as well as the slave breeding argument. Until very recently, the primary contention has been that slavery in the Old South would have proved a non-viable or less than profitable venture had the eastern states not benefited from the sale of slaves to the West.[1] Peter Passel and Gavin Wright have, however, pointed up the interesting possibility that far from needing slave sales to the West, the Old South may have suffered economic losses from its exports.[2] The trade-off is simple—the free movement of slaves from East to West permitted, on the one hand, eastern planters to capitalize on the higher slave marginal product in the West arising, in part, from the expansion of western land; on the other hand, the increased production by eastern slaves sent to the West possibly lowered product prices. Since the price of slaves reflected the net present value of their marginal physical products, the impact on the slave component of eastern assets is ambiguous. But eastern planters owned land as well as slaves. Even if there were potential capital gains to be made from the sale of slaves to the West, there would remain a counterbalancing reduction in land values in the East; the slave exports served to lower both the marginal product of eastern land as well as the price at which that product was

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[1] Alfred H. Conrad and John R. Meyer, "The Economics of Slavery in the Antebellum South," in *The Reinterpretation of American Economic History*, ed. Robert W. Fogel and Stanley L. Engerman (New York: Harper & Row, 1971), pp. 95-130; and Richard Sutch, "The Breeding of Slaves for Sale and the Westward Expansion of Slavery, 1850-1860," Southern Economic History Project Working Paper No. 10, Institute of Business and Economic Research, University of California, Berkeley, November 1972. Eastern states and Old South are used here synonymously.

[2] Peter Passel and Gavin Wright, "The Effects of Pre-Civil War Territorial Expansion on the Price of Slaves," *Journal of Political Economy*, vol. 80, no. 6 (1972), pp. 1188-202.

appraised. An empirical assessment of the Old South's stake in the inter-regional movement of slaves should thus consider the direction and magnitude of changes in both slave and land values resulting from the induced western migration.

Passel and Wright employed a partial equilibrium, one-region model to examine the net effect on overall southern slave prices of western land expansion. We present below a two-region, general equilibrium model of East-West slave mobility. The model permits an empirical analysis of the expansion's effect on the Old South's wealth, land values, slave labor force, slave exports, and slave prices. In addition to reformulating and extending the Passel-Wright question about land expansion, our analysis separates the effects of more western land from that of the slave movement per se. This separation of effects is important; by itself the increase in western land raised western output, diminishing overall output prices. Had there been no inter-regional slave movement at all, the East would have suffered from a reduction in the market value of its fixed output. The export of slaves west either aggravated or ameliorated this initial negative impact of western land expansion. A finding that the overall effect of land expansion in the presence of unrestricted exportation was injurious to the Old South fails to answer the question of whether the slave exports were themselves an offsetting influence. Thus there are two counterfactuals of interest here. First, how would the East have fared had western land expansion been less extensive, given the actual historical circumstances of unrestricted slave exportation? Secondly, given western land expansion, could the East have benefited from restricting the inter-regional movement of slaves?

That an autarkic situation characterized by no inter-regional trade in slaves might have been preferable to any level of free trade seems at first counter-intuitive. The simple barter theory of international trade asserts that some trade is always potentially better than no trade in the absence of market distortions and externalities. The explanation is that no trade in slaves does not mean no inter-regional or international trade at all. The trade literature on optimal tariffs maintains that completely free trade may be less desirable than some restricted level of trade. Seen as an indirect method for the Old South to approach the optimal tariff on trade in final goods, the restrictions on trade in productive factors makes intuitive sense. The two key questions addressed are then: 1) did western land expansion enhance the profitability of slavery in the Old South through the concomitant movement of slaves to the West; and 2) for a given amount of land in the West, did the unencumbered trade and plantation movement of slaves to the West increase or diminish eastern wealth?[3]

Variations in two key parameters, western land and a hypothetical tax on East-West slave movements, constitute our modus operandi. While historically no tax was levied on slave migration, it seems clear that the eastern states had the power to enact such legislation.[4] Federal limitation on westward land expansion, whether through direct legislation or indirect land pricing policies, also appears to have been historically feasible. The reduction in slave exports resulting from the tax would mean less production in the West and thus a higher product price in the East. If we include tax revenues as a component of eastern wealth and ignore redistribution effects, the tax would have the same effect as a slave export quota set by the East. If we impose a tax but do not include its revenues in our definition of wealth, the effect would be the same as a quota in which the East sells at a net supply price and traders or movers capture the differential between the demand and supply prices; this case is also equivalent to a situation of higher transport cost. The hypothetic tax on slave exports is, therefore, a proxy for other export reducing mechanisms. The collection of tax revenues would permit the Old South to act directly as a monopolist in the East-West slave market; with a fixed product price and a less than infinitely elastic western demand for eastern slaves, some positive tax would improve the situation of the Old South. When the product price is also variable, there is an additional monopoly target, the product market, affected by the single-tax instrument. The restriction on slave exports would lead to a higher output price and an additional gain to eastern planters. There exists, then, an optimal tax which through its direct and indirect effects on slave prices would make the Old South unambiguously better off. The case where tax revenues are excluded

[3] We are interested here in the expansion's effect on eastern wealth through its impact on product prices and slave movements. We leave as an open question whether large numbers of eastern planters earned significantly higher returns on their own entrepreneurial talents by themselves moving westward. For the purposes of our analysis, then, we shall permit only slaves to move from East to West keeping the other factors of production, land, capital, and white managerial labor, fixed in the East. These three non-slave inputs form a composite input referred to as "land" below. The probable error involved in assuming only slaves moved West seems small. As Fogel and Engerman assert, "On a majority of the large plantations the top nonownership management was black." See Robert W. Fogel and Stanley L. Engerman, *Time on the Cross*, vol. I (Boston, 1974), 212.

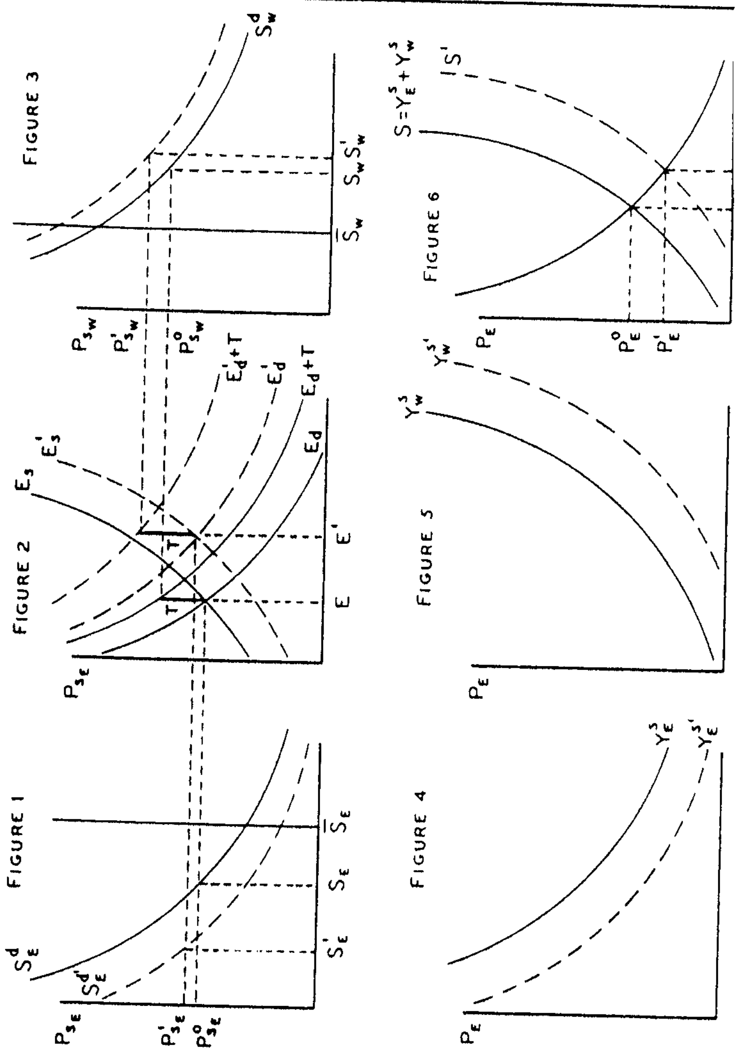
[4] Indeed the Mississippi Constitution expressly prohibited the importation of slaves for sale from 1833 and 1837. Despite this constitutional prohibition, the Mississippi legislature placed a 2.5 percent *tax* on the trade during the period, rather than enforce the prohibition. See Charles S. Syndor, *Slavery in Mississippi*, (American Historical Association, Mass., 1965), pp. 162-68.

from the definition of Old South wealth is, however, the theoretically more interesting one. Here only the indirect effect of restricted slave exports on the product price is operative, and there is an open question whether a tax would leave the final net supply price of slaves above or below the initial value.

The nature of the economic forces to be described algebraically may be seen in the figures. Figure 1 depicts the eastern demand for slaves S_e^d as a function of P_{se}, the price of slaves in the East. $\bar{S}_e$ is the East's initial holdings of slaves, while S_e indicates the number of slaves in the East after market equilibrating migration. Subtracting S_e^d from $\bar{S}_e$ gives the excess supply of slaves in the East, E_s. Similarily Figure 3 provides the excess demand for slaves in the West, E_d. Both of these functions are presented in Figure 2. Assuming a fixed transportation cost, the eastern and western equilibrium slave prices will differ by T. Equilibrium price in the East is P°_{se}, P°_{sw} in the West, and E_0 slaves will be exported East to West. In Figure 4 we graph eastern output supply as a function of price. Its negative slope may be explained in the following manner. Under competitive pricing: $P_{se} = P_{sw} + T$, and $P_{se} = \frac{P_e MP_{se} - M}{r}$ (P_e = product price in East, MP_{se} = marginal product of slaves in the East), assuming a constant interest rate r and making the approximation of an infinite stream of returns (we caution that this is a macro approximation across all slaves). If maintenance costs M are the same in the East and West, and $P_e = P_w$, then $P_{sw} - P_{se} = \frac{P_e}{r}(MP_{sw} - MP_{se}) = T$ in equilibrium. If P_e increased then the differential between slave prices in the East and West will exceed transportation costs and some slaves will be exported to the West. Since $\bar{S}_e$ and L_e, land in the East, are fixed, production in the East must fall as P_e rises.[5] Figure 5 shows that the reverse is true in the West.[6] Higher output prices would lead to expanded production in the West even with fixed land, due to the increase in slave imports from the East. In Figure 6 the eastern and western supply functions, Y_e^s and Y_w^s, are summed together and pictured with the output demand yielding equilibrium P°_e. The dashed curves depict the effects of an expansion of land in the West. We see

[5] Note that the output supply functions take factor marginal products as parameters, while the slave excess demand and supply curves are developed with output price as a parameter.

[6] Strictly speaking this is only correct for a rising price of output; if the price of output falls no exportation will take place. On the other hand, since $MP_{sw} > MP_{se}$, slaves would not be shipped back to the East. The supply curves Y_e^s and Y_w^s become perfectly inelastic for a price decline.



that the effect will be a lower output price and a possibly higher slav price both East and West. On the one hand, the new excess deman curves will shift out due to a higher slave marginal product in the West On the other hand, the fall in output price will shift the excess deman

curve inward and the excess supply curve outward. The final equilibrating export and slave price levels may be less than, greater than, or equal to their initial values. The diagram shows the case of higher exports and slave prices.

The figure points to another interesting aspect of the East-West slave movement. Both the excess demand and supply curves are more elastic than their counterparts without trade. Increases in slave demand from the West could be sustained with smaller price rises due to increased supply from the East. Similarly the East could respond to an exogeneous shift in its slave demand schedule by reducing the volume of exports. The trade had, therefore, a stabilizing effect on slave prices both East and West. The introduction of a proportional tax, tP_{se}, on the slave movement would drive a wedge between excess supply and demand, thus reducing exports. Y_e^s would shift outward and Y_w^s inward, since any rise in the output price would now be met by fewer exports to the West. These shifts would render a higher equilibrium output price in Figure 6.

In the model we make the following simplifying assumptions. Each region produces the same output with land and slaves under constant returns to scale. The product and slave markets are competitive. There is initially a fixed supply of slaves and land in each region. There are constant costs of transporting slaves and output from East to West. Maintenance costs and the interest rate are constant and equal across regions.

Using Euler's theorem we may write output in the West Y_w, and East Y_e, as:

$$Y_w = G_s S_w^d + G_l L_w \tag{1}$$

$$Y_e = F_s S_e^d + F_l L_e \tag{2}$$

L_w, S_w^d and L_e, S_e^d are land and slaves demanded West and East respectively. G_s, G_l and F_s, F_l are the marginal products of slaves and land West and East.

$$Y_s = Y_w + Y_e \tag{3}$$

$$Y_d = Y_d(P_e, B) \tag{4}$$

Total output Y_s is the sum of outputs in the West and East. Demand for the product may be taken as a function of the price in the East, P_e, and an exogeneous component B, such as British exports.

$Y_d = Y_s$ is the equilibrium condition in the product market. (5)

$$S_w^s = \bar{S}_w + E - D \tag{6}$$

$$D = dE \tag{7}$$

$$S_e^s = \bar{S}_e - E \tag{8}$$

S_w^s and S_e^s are slave supplies West and East after trade. $\bar{S}_w$ and $\bar{S}_e$ are initial endowments; E represents exports from the East, while D is the number of deaths resulting from transporting slaves to the West. 7) incorporates our assumption that deaths from exports are proportional to the level of exports. $E - D = E(1 - d)$ represents, therefore, slave imports into the West.

$$P_{se} = \frac{P_e F_s - M}{r} \tag{9}$$

$$P_{sw} = \frac{P_w G_s - M}{r} \tag{10}$$

P_w is the price of output in the West. Equations (9) and (10) are implicit demand functions for slaves in the two regions. They indicate that the price of the homogeneous factor slaves should be equal to the present discounted value of the stream of marginal revenue products net of maintenance costs.

$$S_e^d = S_e^s \tag{11}$$

$$S_w^d = S_w^s \tag{12}$$

These two equations express the equilibrium conditions for the slave markets in the West and East.

$$P_{le} = \frac{P_e F_l}{r} \tag{13}$$

P_{le} is the price of land in the East and equals the present discounted value of the marginal revenue product of eastern land.

$$P_e = P_w + N \tag{14}$$

Here N is the transport cost of moving one unit of output West to East.

$$P_{sw} = \frac{P_{se}(1 + t) + \frac{1}{2}T}{1 - d} + \frac{1}{2}T \tag{15}$$

T is the per slave transportation costs of migration which are assumed to be incurred continuously during the trip; on average slave deaths from transportation will occur in the middle of the trip where half the

costs have been incurred. t is the hypothetical tax rate and d is the transit mortality rate. (15) indicates that the slave price in the East must be discounted by the survival rate $(1 - d)$ in equilibrium.

$$W = P_{se}\bar{S}_e + P_{le}L_e + tP_{se}E \tag{16}$$

W is eastern wealth and is comprised of three components, the value of the stock of slaves $\bar{S}_e$, the value of eastern land, and tax revenues obtained from exportation. Using equations (2), (9), (13), and (8) we may rewrite (16) as:

$$W = \frac{P_e Y_e}{r} - \frac{MS_e}{r} + P_{se}E(1 + t) \tag{17}$$

In this form we see that wealth in the East is generated by the present value of profits from production, plus proceeds from slave sales, less maintenance costs on the slaves S_e remaining in the East. As (17) shows, for $E = 0$, Y_e is a fixed quantity determined by the stock of slaves and land. Land expansion would still reduce P_e, even in the absence of slave movements, by giving slaves already in the West more land with which to work. The question is not whether land expansion by itself hurt the East—that it clearly did by reducing P_e; rather, the issue is whether, for a given expansion of western lands, the proceeds from further exports would outweigh the additional deleterious effect on $P_e Y_e$ brought about by the extra production of the new arrivals in the West. By keeping their slaves in the East the Old South would clearly have suffered an economic loss. The alternative option of selling or moving slaves westward might have alleviated or worsened the situation.

If we take the East to be those states which were net exporters of slaves during the 1850s, we are considering Georgia, Maryland, Delaware, Virginia, Tennessee, Kentucky, South Carolina, North Carolina, and the District of Columbia. In 1860 tobacco accounted for 43 percent of the total value of cotton and tobacco production in these eastern lands.[7] Hence, in our analysis we shall deal with a composite output and consider the possibility that western expansion had no effect on the composite output price in the East—that is, that the demand elasticity for this composite output was infinite.[8]

[7] "Agriculture Census of the United States 1860," Joseph C. G. Kennedy, Superintendent (Washington: Government Printing Office, 1864), pp. 185-87. This Census gives production by state of tobacco and cotton. Cotton prices were taken from Lewis Cecil Gray, *History of Agriculture in the Southern United States to 1860*, vol. II (New York, 1941), 765.

[8] The most appropriate mechanism to analyze this issue is a model permitting two distinct outputs with distinct demands in the East, and one output, cotton in the West. Unfortunately

Returning to the model, (1)-(16) constitute a system of 16 equations in 16 unknowns, Y_d, Y_s, Y_e, Y_w, S_w^d, S_e^d, S_w^s, S_e^s, P_e, P_w, P_{se}, P_{sw}, P_{le}, E, D, and W. The parameters of the model are L_e, L_w, M, r, N, T, d, t. For the purposes of this paper we shall take d = 0. Deaths occurring from transportation of slaves East to West can be broken down into two components; deaths occurring due to the passage of time, and deaths associated with the health hazards of the trip. The static nature of the model rules out the former component as irrelevant. As for the additional risks attendant on travel, one would expect exported slaves to be healthier on average than those not exported and thus better able to endure the rigors of travel. Hence as a first approximation we may take d = 0.

It can be shown that the optimal tax rate t* is given by

$$t^* = \frac{\dfrac{1}{\eta d} + \dfrac{(1-\lambda)\Theta e}{\eta}}{-\lambda} > 0 \tag{18}$$

where $\lambda = \dfrac{P_{se}}{P_{sw}}$, $\Theta e = \dfrac{Y_e}{Y}$, η is the output demand elasticity, and ηd is the excess demand elasticity for slave imports. Here we are holding land in the West constant and assuming $P_e = P_w$, M = 0, (this assumption is dropped below), and unitary elasticities of substitution in both production functions. The more inelastic the excess demand function the greater the potential monopoly rents from enforcing a high slave sale price. Similarly, a relatively inelastic output demand curve permits monopoly interference in that market as well. (18) demonstrates that by taxing slave exports or by selling at demand price under a quota, the East could have exercised leverage in both slave and output markets simultaneously. Only when slave and output demands are both infinitely elastic does it pay not to set a tax. It is also instructive to note that ceteris paribus the optimal tax rate should be higher the higher the eastern share in total output and the higher the initial relative slave price West to East. This is an intuitively clear result reflecting the fact that for high values of Θe and low values of λ the East has relatively more to lose in terms of the exportation impact on output price than it has to gain in the slave trade *per se*.

While the above indicates the benefits that would have accrued to the East had it exercised collective restraint on the movement of slaves, we are interested in historically more realistic questions. Given that the Old South could not have determined the level of exports, would fewer exports—that is, a lower demand for exports, everything else equal—have increased or diminished eastern wealth? The above analysis deriving an optimal tax rate dealt with movements along the excess demand curve; here we are concerned with a shift in that curve, or a movement down the excess supply schedule. To generate a downward shift in the excess demand function with land in the West held constant, we again use the tax construct. But we now exclude tax revenues from the definition of eastern wealth. As may be seen in Appendix B, a reduction of exports will have a theoretically indeterminant effect on eastern wealth. Slave prices may be rising or falling, the output price will rise, exports will decline, land values in the East will increase. For $\eta = -\infty$ the wealth and price elasticities, $\hat{W}/\hat{t}$ and $\hat{P}_{se}/\hat{t}$, take on negative values; clearly if exports have no ill effect on the output price, then any reduction in their level represents an unambiguous capital loss and hence a reduction in eastern wealth and slave prices. Inelastic values for η might for the same reason make non-zero tax rates preferable.

lack of empirical information such as the number of exports of slaves from tobacco vs. cotton states precludes this option. Hence we are forced to deal with a composite tobacco-cotton output in the East.

In Appendix B we derive the Old South wealth, slave price, land price, eastern slave force and slave export elasticities with respect to western land. As in the tax case, a constant output price implies that the Old South could only have gained from the acquisition of new lands or the cultivation of formerly unused lands in the West. The equilibrium position which will be used to give quantitative meaning to these elasticities is the decade 1850-1860. More precisely we shall consider the exportation which took place over that interval to represent E; the slave labor force in the East and West in 1860 to represent S_e and S_w respectively; and 1860 outputs are taken for Y_e and Y_w, et cetera. In Appendix A we list the above presented parameters, together with their numeric values and data sources. Three points bear mentioning here. The East is taken to include those states and the District of Columbia which had positive net exportation rates over the decade: the Carolinas, Georgia, Virginia, Tennessee, Kentucky, Delaware, Washington, D.C., and Maryland. The New South or West includes the net importing states of Texas, Louisiana, Mississippi, Alabama, Arkansas, and Florida. Sugar, tobacco, and cotton define the composite output measured in dollars. The model we have presented assumes the homogeneous factor slave labor, hence a simple enumeration of all slaves of working age would be a gross approximation. Fortunately such an approximation is not necessary. The 1850 census enumerated slaves in ten-year age groups, and five-year age groups for slaves aged 0-20. Using these figures and aggregate slave survival rates, Richard Sutch has computed exportation over the decade by age group.[9] In addition, Fogel and Engerman have calculated net slave earnings by sex and age.[10] Using these figures we converted the slave working population age 10-70 into 33-year-old male earning units and thus obtained a correct measure of our homogeneous variables, E, S_e, and S_w. Our choice of the period 1850-1860 was constrained by the availability of data.[11] During the 1850s an estimated 269,287 slaves moved West, accounting for 32 percent of all migration from 1790 to 1860.[12]

In Table 1 below we present the calculated wealth, slave price, land price, eastern slave and export tax elasticities. Table 2 presents similar calculations for percentage increases in western lands. Values are computed for $\eta = -1$, and $\eta = -\infty$ assuming unitary elasticities

TABLE 1

$\hat{W}/\hat{t}$	$\hat{P}_{se}/\hat{t}$	$\hat{P}_{le}/\hat{t}$	$\hat{S}_e/\hat{t}$	$\hat{E}/\hat{t}$	
.1898	−.1356	.8835	1.007	−6.310	($\eta = -1$)
−.0256	−.5869	.7368	1.270	−7.959	($\eta = -\infty$)

TABLE 2

$\hat{W}/\hat{L}_w$	$\hat{P}_{se}/\hat{L}_w$	$\hat{P}_{le}/\hat{L}_w$	$\hat{S}_e/\hat{L}_w$	$\hat{E}/\hat{L}_w$	
−.2014	−.2707	−.5310	−.2849	1.785	($\eta = -1$)
.0122	.2796	−.3511	−.6053	3.793	($\eta = -\infty$)

$\hat{}$ Percentage change in variable
η Output demand elasticity
W Eastern wealth
Pse Eastern slave price
Ple Eastern land price
Se Eastern slave labor force
E Eastern slave exports
Lw Western land
t Slave export tax

[9] Sutch, "Breeding of Slaves," pp. 42-58.

[10] Robert W. Fogel and Stanley L. Engerman, "The Market Evaluation of Human Capital: The Case of Slavery," unpublished paper presented to the Annual Cliometrics Conference at Madison, Wisconsin, April 27-29, 1972, Charts III and IV.

[11] Prior to 1850 slaves were measured in nondecimal age units; in addition the age categories chosen are different for each census. While it remains possible to obtain an aggregate volume of exports, an export age breakdown for those pre-1850 decades is not forthcoming. Nor is it possible to obtain age group survival rates for the entire slave population due to varying classification procedures.

[12] See Sutch, "Breeding of Slaves," p. 10, and Fogel and Engerman, *Time on the Cross*, p. 47.

of substitution in both production functions. The two tables constitute strong evidence supporting the proposition first advanced by Passel and Wright that the East had little if anything to gain from westward expansion and may have actually suffered substantial losses. For an output demand elasticity of −1, the wealth-western land elasticity is −.2014. A 100 percent increase in western lands would mean a 20 percent reduction in the value of eastern assets. Even if the output price had not fallen, the East stood to gain very little from the migration. A 100 percent increase in western acreage could have increased Old South wealth by less than 2 percent. One could counter with the argument that it was the added lands themselves that reduced eastern wealth, and that the East needed slave exportation to sustain its position. But this thesis is rejected in Table 1. A 100 percent increase in our tax parameter t, effectively halving the eastern net slave supply price, would have reduced eastern wealth by less than 3 percent in the case of an infinitely elastic output demand schedule. It appears that the notion of Old South dependence on western expansion is without basis in fact. The elasticities presented indicate that historians have placed too much emphasis on slave prices to the neglect of land (all non-slave factors) valuations. Although slave prices rise by .279, land prices fall by .351 in response to a one percent increase in Lw, even when P_e is constant. The intuitive explanation for this is that higher slave marginal products barely offset the lowered land marginal product. If the output price is permitted to fall as well, then the majority of forces works to reduce eastern wealth.

It is important to test the sensitivity of these results to possible errors in parameter estimates. For this purpose we consider the case $\eta = -\infty$, our most conservative estimate of η; under this assumption the wealth-land elasticity becomes

$$\hat{w}/L_{\hat{w}} = \frac{\frac{\psi}{r}(\alpha - 1)\alpha l_e \gamma(\beta - 1)\mu\beta\Theta_w}{\mu(1 - \beta)\beta\gamma\Theta_w\sigma_e + \frac{(1 - \alpha)\alpha\Theta_e\sigma_w}{\gamma}}$$

and the wealth-tax elasticity is:

$$\frac{\hat{w}}{\hat{t}} = \frac{\frac{q\psi(1 - \alpha)\alpha l_e}{\sigma_e}}{\frac{(\alpha - 1)\alpha\Theta_e}{\sigma_e} + \frac{\mu\gamma^2(\beta - 1)\beta\Theta_w}{\sigma_w}}$$

In considering different values for σ_e and σ_w, the elasticities of substitution of the two production functions, we need only consider values for the two numbers less than one. The smaller the opportunity to substitute land for labor, the greater the effect on slave prices East and West resulting from the land expansion and the ensuing short supply of slaves. Even such a low figure for σ_e and σ_w as .25 would, however, raise the wealth-land elasticity to less than .05. In the calculations leading to Tables 1 and 2, we took $\mu = P_w/P_e = 1$. This implies negligible transportation costs of shipping agricultural products from West to East and is probably an overstatement of μ. Lower values for μ would reduce $\hat{W}/\dot{L}_w$ from its level of .0122 and strengthen our conclusion that western expansion had a negative or insignificant impact on eastern wealth. A reduction in r from 10 to 5 percent would bring $\hat{W}/\dot{L}_w$ to .0244, still extremely small. Of all the parameters here estimated, α and β stand most in doubt. If we assume $\alpha = .5$ and $\beta = .5$ rather than $\alpha = \beta = .58$, $\hat{W}/\dot{L}_w$ takes the value .0125, the largest value for any combination of α and β. Finally we must consider any possible errors in le, γ, Θw, and Θe. These parameters deal with relative slave labor forces, output levels, and exportation magnitudes East and West. The most likely source of error associated with this set of parameters is the dynamic element of population growth not captured in a static model. In 1850 before migration, $\bar{S}_e$ includes all slaves age 10 to 70 in the East. In 1860 after the movement of slaves to the West, our $\bar{S}_e$ equals exports plus slaves in the East, aged 10 to 70, alive in 1860. Hence there is a discrepancy between $\bar{S}_e$ 1850 and $\bar{S}_e$ 1860 due, on the one hand, to the entrance into the 1860 slave labor force of those under ten in 1850; on the other hand, there are departures by 1860 through the increased age and death of 1850 participants. Given a positive population growth, one would expect our values of S_e and S_w to be biased upward. The ratio $\gamma = S_e/S_w$ should, however, be roughly invariant to population growth if both regions exhibit the same birth and death rates. In any case $\hat{W}/\dot{L}_w$ is insensitive to reasonable variations in γ. Θe and Θw will be unaffected by the population growth as well, if our assumption $\alpha = \beta$ is correct. To see this we can rewrite $\Theta e = Y_e/Y_w + Y_e = \dfrac{1}{\dfrac{Y_w}{Y_e} + 1}$. α and β are output elasticities with respect to slave labor. If the percentage increase in the slave working force is the same in both regions, the percentage increases in Y_w and Y_e will be identical East and West, hence Y_w/Y_e, and thus Θe and Θw will not be altered by

population growth. $le = E/S_e$ remains to be considered. It is probable, given the above results, that the growth in population reduced Pe, the output price, and thus the gap between slave prices East and West. This, in turn, would imply fewer exports than would otherwise have been the case. Our value for le = .1596 may be biased downward. But a higher vaue for le of .25 yields a wealth-land elasticity of .019, still quite a minor effect. Similar sensitivity tests may be done for $\hat{W}/\hat{t}$ for $\eta = -\infty$. In no case do reasonable variations in our parameter estimates yield values for $\hat{W}/\hat{t}$ greater in absolute value than .05. Tables 1 and 2 indicate that exportation is highly responsive to increases in western lands and other shifts in the excess demand curve. A doubling of western land entails a 300 percent or greater increase in exports to the West. This result is in full accord with what actually transpired; there was—in the words of Fogel and Engerman—a "remarkable change in the geographic location of the slave population."[13]

In this paper we have attempted to illuminate the theoretical determinates of the East-West slave migration and to resolve the issue of the migration's impact on the Old South. Our results constitute a strong refutation of the historic claim that the Old South needed western expansion and slave exportation to prosper. The East had very little, if anything, to gain in the economic sphere from the expansion. More probable is the notion that eastern wealth declined substantially as more and more slaves moved to the West. The analysis shows the eastern exports, slave prices, and land prices were highly sensitive to changes in New South land area. While one may still argue an eastern dependence on western expansion for political and military purposes, the Old South had no economic stake in the New South.

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[13] Fogel and Engerman, *Time on the Cross*, p. 44.

APPENDIX A

PARAMETERS, VALUES AND SOURCES

Parameter	*Estimate*	*Source*
α β	.58 .58	Fogel and Engerman estimate a Cobb-Douglas function for the entire South and find the slave share is .58. We assume both production functions exhibit identical coefficients equal to .58. Source: *Time on the Cross*, vol. II, p. 58, Appendix B, Table B-21.
E	140,692	Measured in units of male slaves 33 years old, computed from Sutch's export figures and Fogel and Engerman tables on earnings by age and sex. Sources: Sutch, "The Breeding of Slaves for Sale and the Westward Expansion of Slavery, 1850-1860," pp. 42-58; and Fogel and Engerman, "The Market Evaluation of Human Capital: The Case of Slavery," Charts III and IV.
Se Sw	881,200 699,473	Both Se and Sw are measured in units of 33-year-old male slaves. Working age (10-70) slaves were enumerated in the 1860 Census by state, age group, and sex. As with E these figures were converted to male 33-year-old equivalents using Fogel and Engerman's earnings by age. The enumerations of E, Se, and Sw in Sutch's paper and the Census are by age group, not individual age. Hence an average earnings figure was used for each age grouping. Sources: U.S. Census Office, "Population of the United States in 1860: The Eighth Census."
$\gamma = S_e/S_w$	1.26	
$h = \frac{PeFs}{PeFs - M}$	1.1	Estimate of h used by Passel and Wright in "The Effects of Pre-Civil War Territorial Expansion . . . ." p. 1197.
P_eY_e P_eY_w $Y = PeYe + PeYw$	94,522,323 191,280,346 285,802,669	The composite output includes sugar, tobacco, and cotton. Physical output by state is found in the "United States Census of Agriculture, 1860," pp. 185-87. Commodity prices in the East were obtained from Lewis Cecil Gray's *History of Agriculture in the Southern United States to 1860*, vol. II, pp. 765, 1033.
P_{Se} P_{Sw}	1,398 2,024	Slave prices for 33-year-old males were used here, taken from Charts I and II of Fogel and Engerman, "The Market Evaluation . . . ." These charts give average prices by age for 1845-1855. To obtain equivalent 1860 prices we used the index of slave prices in Ulrich Bonner Phillips, *American Negro Slavery* (1918; reprint ed., New York: Peter Smith, 1952), p. 371.
$\Theta e = \frac{PeYe}{Y}$	.3307	
$\Theta w = \frac{PeYw}{Y}$	.6693	
$P_{Se}S_e$	1,231,917,600	
$q = \frac{P_{Se}S_e}{P_eY}$	4.31	
$\mu = \frac{Pw}{Pe}$	1	Comparison of commodity prices in New Orleans and Virginia as presented by Phillips and Gray show identical prices for tobacco, cotton, and sugar in 1860.
$\bar{S}e = E + Se$	1,021,892	
η		Varying values of η are tried in the paper.
$\Psi = \frac{PeYe}{W}$	.0518	To compute W we used the fact that $W = P_{Se}\bar{S}e + P_{le}L_e = P_{Se}\bar{S}_e + \frac{PeFl}{r} Le = P_{Se}\bar{S}_e + \frac{Pe(1-\alpha)Ye}{r}$
$lw = \frac{E}{Sw}$	.201	
$le = E/Se$	.1596	
r	.10	Ten percent is average rate of return earned by slave-owners (reported by Fogel and Engerman, *Time on the Cross*, p. 70).
σe, σw	1	Elasticities of substitution of production functions East and West. We follow Passel and Wright in taking $\sigma e = \sigma w = 1$ for initial values.

APPENDIX B

Assuming d = 0 equations 1-16 may be reduced to the following three equations in Se, Pe, and W.

$$W = \frac{(P_eF_s - M)}{r}\bar{S}_e + \frac{P_eF_l \cdot L_e}{r} + t\frac{(P_eF_s - M)}{r}(\bar{S}_e - S_e) \quad \text{(B1)}$$

$$G_s(\bar{S}_w + \bar{S}_e - S_e, L_w)(\bar{S}_w + \bar{S}_e - S_e) + G_l(\bar{S}_w + \bar{S}_e - S_e, L_w) \cdot L_w \quad \text{(B2)}$$
$$+ F_s(S_e, L_e) \cdot S_e + F_l(S_e, L_e) \cdot L_e = Yd\,(P_e, \beta)$$

$$\frac{(P_e - N)G_s(S_w + \bar{S}_e - S_e, L_w) - M}{r} = \frac{(P_eF_s - M)}{r}(1 + t) + T \quad \text{(B3)}$$

Below we totally differentiate the above three equations permitting Lw and t to vary. The resulting differentials are expressed in rate of change form (denoted by ˆ) and evaluated at t = 0.

$$(\alpha\Theta e - \gamma\beta\Theta w)\,\hat{S}e + (1 - \beta)\Theta w\hat{L}w = \eta\hat{P}e \quad \text{(B4)}$$

$$\left(\frac{\beta\gamma\Theta w - \alpha\Theta e}{\gamma}\right)\hat{P}e + \left(\frac{\mu(1-\beta)\beta\gamma\Theta w}{\sigma w} + \frac{(1-\alpha)\alpha\Theta e}{\gamma\sigma e}\right)\hat{S}e \quad \text{(B5)}$$
$$+ \left(\frac{\mu(1-\beta)\beta\Theta w}{\sigma w}\right)\hat{L}_w = \frac{rqt}{\gamma}$$

$$\hat{w} = \left(\psi/r\,\frac{(\alpha - 1)\alpha le}{\sigma e}\right)\hat{S}e + \left(\psi/r(\alpha le + 1)\right)\hat{P}e \quad \text{(B6)}$$

Alternatively setting $\hat{L}w$ and $\hat{t}$ equal to zero, the elasticities of eastern wealth with respect to the tax rate parameter and western land are:

$$\hat{w}/\hat{t} = \frac{rq(HI/\eta - X)}{R + I^2/\eta} \quad \text{(B7)}$$

$$\hat{w}/\hat{L}w = \frac{H(L(I^2/\eta + R) - RK) - XKI}{((I^2/\gamma\eta) + R/\gamma)I} \quad \text{(B8)}$$

where:

$$X = \frac{\psi(\alpha - 1)\alpha le}{r\sigma e} \quad H = \frac{\psi(\alpha le + 1)}{r} \quad I = (\beta\gamma\Theta w - \alpha\Theta e)$$

$$R = \frac{(\alpha - 1)\alpha\Theta e}{\sigma e} + \frac{\mu\gamma^2(\beta - 1)\beta\Theta w}{\sigma w}$$

$$K = \frac{(\beta - 1)\Theta wI}{\eta\gamma} + \frac{(\beta - 1)\mu\beta\Theta w}{\sigma w} \quad L = \frac{\mu(\beta - 1)\beta\Theta w}{\sigma w}$$

(B4) and (B5) provide solutions for $\hat{S}_e/\hat{L}w$, $\hat{S}_e/\hat{t}$, $\hat{P}_e/\hat{L}w$, and $\hat{P}_e/\hat{t}$. These values are used with the equations below to obtain values for $\frac{\hat{P}_{se}}{\hat{L}w}$, $\hat{P}_{se}/\hat{t}$, $\hat{P}_{le}/\hat{L}w$, $\hat{P}_{le}/\hat{t}$, $\frac{\hat{E}}{\hat{L}w}$, $\hat{E}/\hat{t}$.

$$\hat{P}_{le} = \frac{\alpha}{\sigma e}\hat{S}e + \hat{P}e \tag{B9}$$

$$\hat{P}se = \frac{h(\alpha - 1)}{\sigma e}\hat{S}e + h\hat{P}e \tag{B10}$$

$$\hat{S}e = -le\hat{E} \tag{B11}$$