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A new Ricardian model of trade, growth and inequality – The role of financial capital

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A New Ricardian Model of Trade, Growth and Inequality- The Role of Financial Capital

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ABSTRACT

The classical Wage Fund (Financial Capital) framework is integrated with the Ricardian model of comparative advantage. It can easily and effectively reflect on critical contemporary issues without the ammunitions of a more complex neoclassical system. Some of the results are as follows. Trade pampers inequality across the globe independent of trade patterns. It is likely to increase growth rate but that rate declines over time. Technological progress without capital accumulation magnifies inequality in or out of steady state. Financiers may wish to invest in innovations and outsource production to the rest of the world. Financial crisis in terms of credit shortage hurts workers but benefits capitalists etc. Interestingly this Ricardian model with capital and labour replicates many iconic neoclassical results without neoclassical assumptions.

Key Words – New Ricardo, Neoclassical, Trade, Growth, Inequality

JEL Cl. No –F1, O4, B4

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Section 1 Introduction

This paper brings in the classical wage fund framework incorporating finance or financial capital (K) in a standard 2x2 Ricardian model of trade and comparative advantage. Start-up level of K inherited as savings from the past, determines wage rate today given that labour has to be fully employed. Thus, we have a new Ricardian model with financial capital and labour. We derive many interesting results, broadly consistent with empirical observations. Trade pampers inequality between capital and labour across the globe, independent of trade patterns. Income share of labour declines due to trade and technological progress. Trade is likely to increase growth rate but that rate declines over time. Technological progress without capital accumulation magnifies inequality in or out of steady state. Financiers may wish to invest only in new technology generating activities and outsource production to the reast of the globe. Financial crisis in terms of shortage of credit hurts workers but benefits capitalists etc.

This new Ricardian model with both capital and labour can replicate many results of the neoclassical production theory under competitive conditions without any reference to the concavity and/or the critical assumption of CRS production function. It can reproduce the fundamental and iconic results of Solow (1956) or Phelps (1965). Hence, it is also a contribution towards the history of economic thought

The main purpose of this paper is to bring in finance in a standard model of international trade and explore its implications for trade, growth and inequality. This paper is not about imperfect credit markets or implications of financing international trade. We like to investigate what happens if we mix and match a distortion free Ricardian trade theoretic framework with a perfect capital market. How does this Ricardian model with capital behave and what kind of results of contemporary relevance it can generate. It is well known that credit market and international trade is a topic with not many theoretical contributions, with the primary focus being the role of imperfections in credit market and/or the role of credit that finances trade. For general equilibrium perspectives of these issues interested readers may look at Jones and Marjit (2001) Matsuyama (2005), Wynne (2005), Antras and Caballero (2009), Marjit and Mishra (2020) etc. In this paper we ask a question that should have been asked long ago in this literature. At any point time if total finance is given to the

system and such financial capital is available at a market determined competitive interest rate, how it impacts trade and associated features such as growth and inequality. The literature mainly concentrated on imperfections in credit market and/or financial requirement of trade credit needed for international transactions without asking a more primitive and fundamental question as to what inclusion of finance in general does to the existing trade models. This paper attempts to bridge this gap by starting with the Ricardian model and demonstrating its potential for many interesting results.

The paper is related to Ricardo's original work (1817) and contributions by Findlay (1974, 1984, 1995), Hicks and Hollander (1977), Steedman (1979), Maneschi (1983,2008). Typically, the classical model has been modelled in some of these papers by adhering to the basic presumption of the classical system regarding the labour market i.e. unlimited supplies of labour at a given real wage. The use of neoclassical tools such as marginal product of labour has also been common either to characterise the wage unemployment adjustment process (Hicks and Hollander 1977) or to characterize the agricultural sector. The missing link seems to be the lack of use of the wage fund framework in a situation of full employment which we analyse in this paper.

More recently Marjit, Mandal and Nakanishi (2020) , Long and Nakanishi (2020), Kikuchi and Marjit (2011) and Marjit and

Mandal (2017) have built on Marjit (2007) which explores Ricardo in the context of trade on virtual platforms. However, for contemporary issues discussed in the paper on trade inequality, growth etc. one can refer to the outstanding graduate text by Feenstra (2003) and for exhaustive survey of recent extensions of the Ricardian model of trade to the lecture sides of Autor (2018). But none of the materials referred above has used the structure we are developing in this paper.

The paper is laid out as follows. Section 2 and its various subsections deal with the basic model , the benchmark result and its various extensions and the last one concludes

Section 2 Model and Results

A country produces two goods of amounts X_1 and X_2 with only Labour in total quantity L, a constant. Per unit labour coefficients are given by al_1 and al_2. Goods are sold at a competitive price P_1 and P_2. We choose good 2 as the numeriare with $P = P_1/P_2$. In fact all variables are measured in the units of the second good.

At the beginning of the production period workers are hired and wages are paid before the outputs are realized. The wage fund or the sum is borrowed at a rate of interest r and after the revenue is realized producers pat back the principal with interest. The wage fund is given at the start of the period by previous accumulation process defined as capital in the model and denoted by K.

To absorb the entire L, given K ,W has to adjust such that

$$W = K/L \qquad (1)$$

(1) relates W positively to K/L . Note that the relationship qualitatively is the same for a CRS production function with diminishing marginal productivity, most commonly used in neo classical production theory.

Competitive price conditions will yield

$$W\, al_1\, (1+r) = P \qquad (2)$$

$$W\, al_2\, (1+r) = 1 \qquad (3)$$

(2) and (3)give us the same relative price as in the standard text book example with both sector paying same W and r in equilibrium under autarky.

We assume homothetic demand function which leads to the following market clearing condition

$D(P) = X_1/X_2$ (4)

Full Employment condition

$al_1X_1 + al_2X_2 = L$ (5)

(1)-(5) determine W, P, r, X_1 and X_2

Point to be noted is that W is determined exclusively from K/L. One could interpret K/W as the demand curve for labour (Figure-1). As W goes up the same K can employ less workers. With the full employment constraint a unique W is determined which absorbs L. As W goes up r must fall given the competitive price conditions (Fig-2).

Typically in the classical system real wage is assumed to be given and unlimited labour supply is available at that real wage, mimicking the state of the economy around the age of industrial revolution. More modern versions of the classical Ricardian system incorporate a mix of such system with diminishing marginal productivity in agriculture. In the present set up W is perfectly flexible but is determined by the available stock of capital and the size of the labour force. Any deviation of W from K/L either leads to a rise or a fall in the wage rate due to competitive pressure. K/W> L implies a rise in the wage as demand exceeds supply and K/W< L leads to a drop in W due to excess supply of workers.

Suppose K and L grow at the same rate. Note that W remains frozen. Also P does not change pegged by technologies. But aggregate income goes up for workers and capitalists i.e. the owners of capital. Relative outputs have to remain the same though higher L will increase both Hence, both outputs will increase at the same rate. Thus following uniform growth in K and L, outputs grow at the same uniform rate. Though demand plays a role here, the result, de facto, has a CRS

flavour. The only twist is that along such a balanced growth path W and r do not change. In this model W/r remains the same as long as K/L does not change. This happens from the supply side. But the mechanism is completely different from the standard production models.

2.1 International Trade

Consider a situation where the world relative price P* is greater than P, the autarkic relative price of X_1. The usual and predictable outcome is that the country will specialize in production of the first good. That will maximize the value of production at world prices. This will imply a rise in r and all L will flow into this sector and hence K.

W remains the same as K/L remains the same i.e. the real wage in terms of the import good, the numeriare, does not change. But as P rises real wage is likely to fall assuming workers consume both goods.

(1+r) must rise as P rises and in the same proportion with P. r rises in terms of the import good and real return to capital must go up. So real wage falls and real return to capital increases. Note that this will be

the outcome independent of the pattern of comparative advantage. If this country was importing X_2, the same thing would have happened. Real wage would have fallen and real return to capital would surely rise.

This is like the well-known Stolper Samuelson result but it holds independent of the "factor intensity" ranking. One can easily show that capital intensity of production (WLi/WL) will rise for the export good in both countries.

We should highlight a point that is critical from a distributional point of view involving K and L. It is undesirable to assume that workers in the system would not own any capital. Let us assume that a fraction of K is owned by the workers and hence they do get the benefit of a rise in r. But still the following proposition would hold.

Proposition 1-

a) *International Trade must reduce the real income of the workers and inequality between labour and capital income rises*

independent of the pattern of trade, assuming that the workers do not own capital and earn less than the capitalists to start with.

b) *If workers own a part of the capital stock their real income can still go down and inequality will rise even if their real income goes up.*

Proof –

Proof of part a follows from discussion above.

Part b - Suppose a fraction α of K is owned by the workers. Then their real labour income will be given by

$W_R = (WL + \alpha rK)/P = [K (1-\alpha) + \alpha (1+r) K]/P$, (as K/L = W)

Since (1+r) and P increase by the same proportion, real wage must fall with a rise in P. QED

Double sided wage inequality by which trade worsens inequality between the skilled and unskilled workers in both trading countries has been an intriguing feature as the standard Heckscher-Ohlin-Samuelson model predicts asymmetric response. Voluminous literature exists and has been discussed in Feenstra and Hanson

(1996), Feenstra (2003), . Marjit and Acharyya (2003) have analyzed these cases for the developing countries and Marjit and Acharyya (2007) provide a detailed survey of the literature. What we have shown here is that such a result relating capitalists and workers has a natural outcome in our model which occurs independent of trading patterns. The rising income gap between capital and labour echoes the concern of many and notably that of Picketty (2013).

Point to note is that trade leads to the entire allocation of K to the more profitable sector without any impact on W and raising r in both countries. Trade in this set up continues to depend only on technological differences and trade is entirely driven by technology even if the stock of finance is essential for production to take place.

Proposition 2 - Factor endowments do not affect the pattern of trade, but only factor returns.

Proof- The proof is fairly straight forward. K/L determines W and hence r but not P which is pegged by technology. Higher K/L means higher W and lower r before trade takes place. Once trade takes place

and the country gets completely specialized, a rise in K/L will do the same, raising the wage and reducing r. But nothing else should change. QED

2.2 Economic Growth

Ricardo's original work stressed the significance of capital accumulation and how the principle of comparative advantage could positively impact industrial revolution in England. He proposed the repeal of corn-law, which happened in 1846. That made import of corn, the wage good, cheaper boosting rate of profit and rate of accumulation. Trade according to British comparative advantage in industrial goods was supposed to stimulate trade and growth at the same time. His was the first model of trade led endogenous growth. Similar process can work on virtual platform where trade automatically leads to higher productivity and hence growth in an otherwise Ricardian set up.

Classical economists often made a common assumption that capitalists save and invest all their profits and workers consume all

their income. We do not need to make such assumption as workers can own capital and invest. In this simple model we postulate that all profits are invested, whoever earn it. To make it look like the Solow model we assume that L grows at an exogenous rate n.

Let K_t be the capital stock at t , then

$K_{t+1} = K_t$ (1+r) and similarly

$L_{t+1} = L_t$ (1+n)

Therefore, K/L grows at a rate (1+r)/(1+n).

Proposition 3 – A unique and stable steady state growth path exists with r = n

Proof- Start from any K/L and we have a unique closed economy equilibrium values of P and r, given K/L=W, and assumptions of the model. First, we show that if there is a steady state it must give us a unique set of values of the variables.

Steady state implies r=n. K/L is a constant, so is W andgiven W all other variables have same values over time. Hence, it is unique.

Given n>0, we can solve for r = n, if there is a solution for the system at initial K/L, the same solution will persist for r = n. Hence, a steady state exists.

Suppose r>n, K/L is rising, so is W (P is frozen by technology) and r will fall up to n. Once it reaches n, it will remain there as K/L will reach its steady state value.

Suppose r< n. K/L is falling, so is W and r will be rising until it hits n and steady state will be reached.

Thus the steady state equilibrium is stable. This completes the proof. QED

The same story will be repeated for a completely specialized economy trading at world prices.

Note the similarity with the Solow (1956) model of growth. Per capita income does not grow in steady state and income grows at the natural rate n as in the Solow model. The convergence to the steady state is not guaranteed by diminishing returns as in the neo-classical model, but through a rise in r followed by a drop in W when K/L falls and

through a fall in r when W rises and K/L rises. We replicate all results usually derived via the marginal productivity theory of distribution. Countries with lower K/L grow faster because of the decline in the wage rate. Thus typical Solow model driven idea of absolute convergence holds.

Proposition 4 – Trade can only temporarily boost up growth in per capita income but in the long run per capita income will depend only on steady state K/L [= (K/L)]*

Proof – Let us tart from (K/L)* and go for trade at world prices which are different from local prices, which lead to complete specialization raising r beyond n. K/L and W start rising and r starts falling up to n reducing the growth of capital and eventually converging to r. Thus over some periods per capita income must rise as r>n. In fact during the transition process per capita income will be given by

$Y_t = Y^* + F[(K/L)_t - (K/L)^*]$, $F[0]=0$, $F' > 0$,

where $Y^* = (K/L)^* (1+r^*)$is the steady state per capita income.

As trade leads to a jump in r, Y increases and K/L starts rising and r starts falling, dragging K/L down to the steady state. Thus the growth in per capita income falls to zero eventually.

QED.

2.3 Optimal Growth under Free Trade

We have demonstrated that this new Ricardian model exhibits similar properties as in a Solow type model. Now we turn to optimum growth in this context. We talk about the nature of optimum growth under free trade. It is obvious that under free trade the country is likely to be completely specialized in production given a set of world prices captured by P* while consuming all goods available. We assume that P* does not change overtime, though this turns out to be a redundant assumption for our purpose as would be revealed soon.

We follow a standard saving-investment process unlike the classical view that capitalists save and workers consume. As stated earlier workers can own capital and therefore income can be different from

W for a typical worker. Each and every agent has the same instantaneous utility function defined over available consumption goods and also the same rate of time preference captured by a discount rate $\beta = 1/1+\rho$ with $\rho\varepsilon$ (0, 1) is the pure rate of time preference. Agents will maximize discounted sum of utilities over infinite horizon subject to a dynamic budget constraint that takes into account the natural growth rate of L as n and required investment in K. I shall first derive the steady state result based on the Euler's condition intuitively to find out the optimal K/L to derive what is known as the "Modified Golden Rule". Then the explicit dynamic programming exercise will be outlined by specifying the Bellman equation.

Think of investing 1 unit of K at period t in a two period model with (t, t+1) as the relevant periods. Whichever consumption good you focus the sacrifice will mean marginal utility or MU at t i.e. MU_t. If K grows at a rate r it has to be the case that it covers the extra labour that it has to employ as L is growing at a rate n. So (r-n) is left over and above

such requirement and total extra income to be spent will be given by [1+(r-n)]. The utility value of that in present terms will be

$\beta MU_{t+1}[1+(r-n)]$. Optimality implies this has to be equal to MUt. Under steady state (or stationary state as per capita income is not growing and is a constant), this will boil down to

$r = n+\rho$

This is the well-known modified golden rule result. Given the natural rate of growth and pure rate of time preference, r will be determined and since it is a monotonically declining function of K/L , a unique K/L will be determined.

Just to reiterate the point that the supply conditions of the model is completely Ricardian and we have used marginal analysis in consumption to compare it with a very conventional result of optimal growth in neoclassical models. Thus we demonstrate that golden rule or modified golden rule that is fundamental to the optimum growth literature in neoclassical models is also captured in the new Ricardian model we develop here.

2.4 Technological Progress

This model has another interesting feature. Any kind of technological progress without the growth in K/L does not improve the economic conditions of labour. With K/L held fixed W will not rise but a fall in labour coefficients will raise r. If we start from a steady state , r will rise and K/L will start growing only then W can rise. But at a steady state W will remain the same but r will be higher with technological progress. Technology does not help workers because given amount of wage fund and the size of the labour force there is only one wage rate than can be paid to the workers and that remains insulated from technological progress. Quantities increase and the higher value of income is all retained by the capitalists. Pre trade uniform technological progress across sectors will have usual outcomes as in Ricardian model. With trade it will be only for the single traded sector.

Proposition 4 – Technological Progress will increase return to K while W does not change.

Proof- See the discussion above.

One could conceive a slightly different set up where there is an R and D sector which uses labour to reduce the labour coefficient. In the completely specialized world al_1 gets reduced by employing L_d amount of workers through the following function

$$al_1 = A(L_D),\ A(0) = al_1(0) > 0 \text{ and } A' < 0 \qquad (6)$$

Note that K is divided between wage funds deployed in two sectors, X_1 and D with workers paid the same W. ($L - L_D$) will be allocated for production and the rest for R and D.Interestingly the equilibrium level of L_D is indeterminate as more is invested in D , higher will be r . In principle close to all K should be invested in D sector to maximize income from capital or wage fund i.e. rWL, with both L and W held constant. In fact as Beladi, Jones and Marjit (2002) show zero production can be a feasible equilibrium in a Ricardian trade model if technology could be sold out to the rest of the world against a proper fee. However, main point is that wage does not increase with technological progress but r does.

Proposition 5- Both trade and technological progress contribute unambiguously to rising inequality.

Proof- See the discussion above. QED

Now consider a case where K, L and L_D all are growing at the same rate n. We have already shown that in such a state as K/L does not change W remain the same but growth in R and D will continuously reduce the labour coefficient and hence r will increase. Hence, the growth rate of r will be greater than that of W which does not change. Thus the outcome of the steady state can be a continuous rise in inequality with income from K growing faster than that of labour. This is a similar situation as emphasized by Picketty (2013) in his celebrated book, but ours originates in this new Ricardian structure.

Section 3 Concluding Remarks

A text book Ricardian model stapled with the wage fund hypothesis, defined as the New Ricardian model, captures the classical notion of

capital (K) or working capital or credit. Bringing in K in this model leads to neo-classical type relationship between factor endowments and factor prices, though income distribution between labour and capital is fuelled by entirely different mechanisms. We replicate the fundamental results of the Solow (1956) paper and those related to optimal growth. There are certain robust outcomes which are quite interesting from contemporary perspectives such as unambiguous rise in inequality due to trade and technological progress all across the globe.Trade benefits growth but not over the long run. Key to rising wage and decline in inequality is physical accumulation of capital, but not technological change. Trade increases credit intensities of the export good and may encourage more or less credit intensive sectors. Only technologies determine trade pattern not factor endowments i.e. labour and credit supply. Interesting extension can be done in terms of the impact financial crisis and trade as the supply of credit is affected and possible overall impact on demand.

The limitation of this approach is that it is based entirely on a notion of working capital as given by the classical wage fund system and

completely abstracts from the role of capital inside the production process , not only as the source of finance. Hence, we cannot talk about fixed investments. But role of capital in innovations has been accommodated, leading to a impact that lingers over time. The decision to allocate K for R and D now has to be based on a dynamic choice which we do not model here explicitly. Thus finance in the current period does have significant future implications from the supply side. Our ongoing work deals with the role of finance in Heckscher-Ohlin -Samuelson Model and Krugman-Dixit-Stiglitz Product Variety models.

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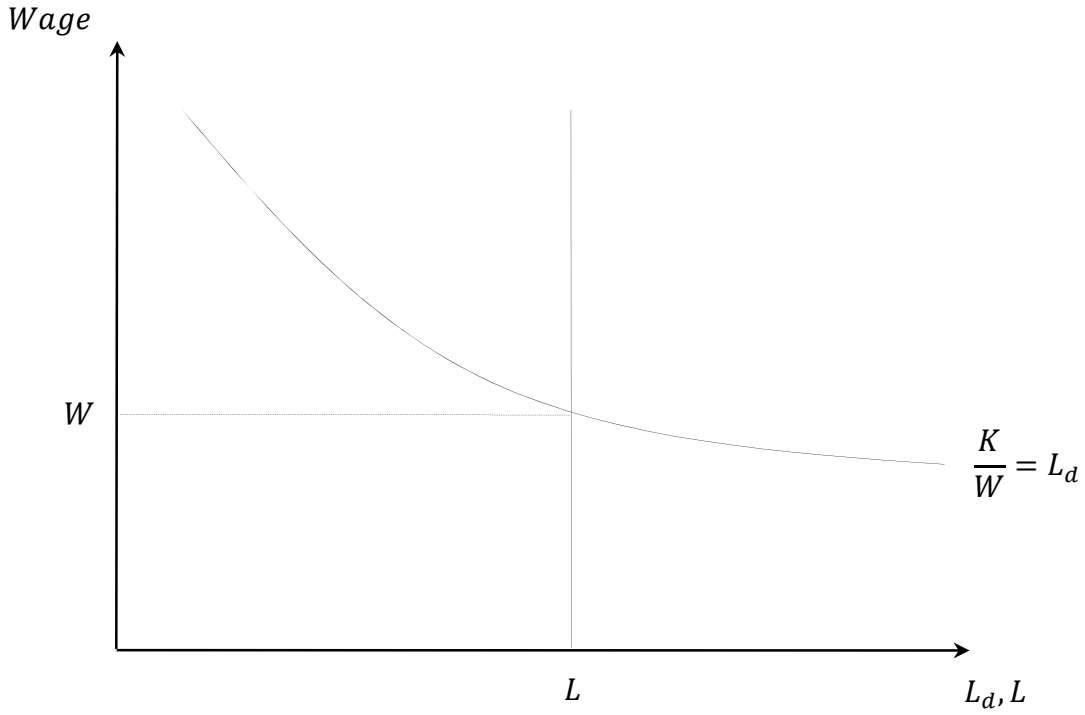

Figure 1

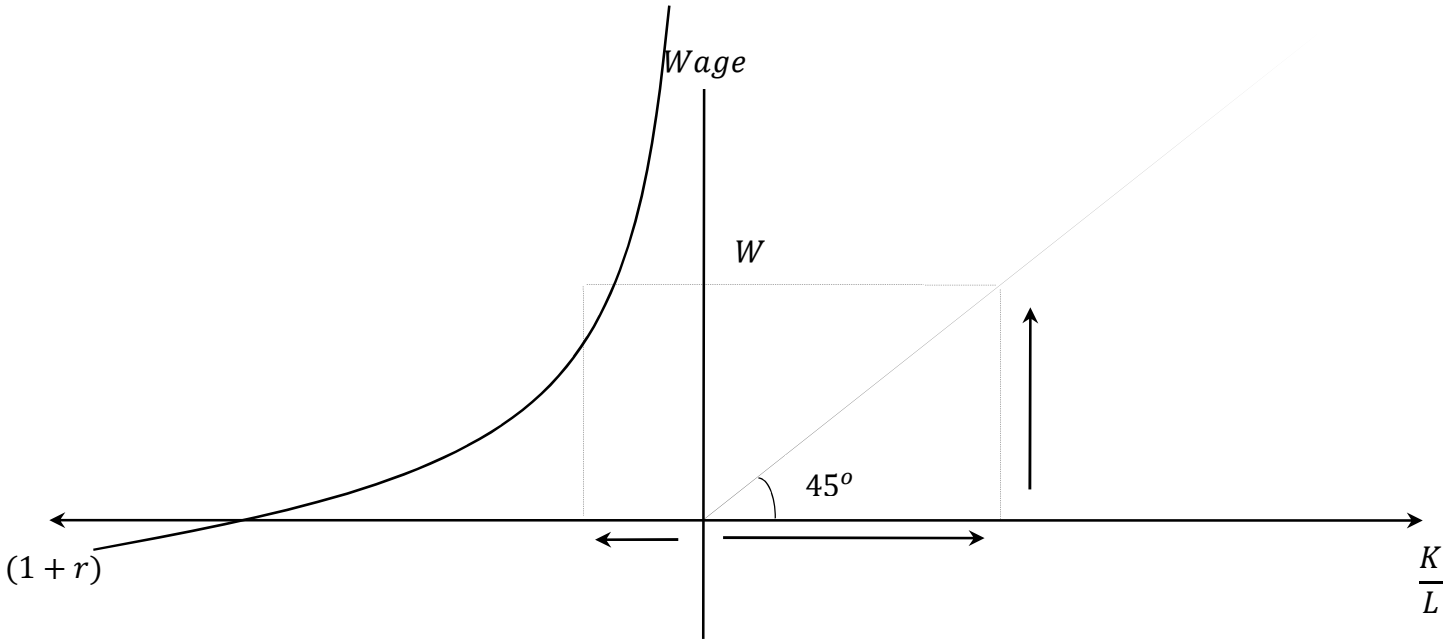

Figure 2