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I. INTRODUCTION

Many countries now actively encourage the immigration of entrepreneurs and investors, and often require business immigrants to import a minimum amount of capital and to be employed in the firms in which their capital is utilized. Business immigration of this type affects both the supply of labour and capital, and, in the long-run, the steady state capital labour ratio. The effect of business immigration on income distribution in the long-run is not obvious, and neither is optimal immigration policy.

In a recent paper,[1] we have analyzed business immigration in the context of the Solow-Swan neoclassical growth model. It turns out that for a given saving rate, optimal business immigration will always benefit workers at the expense of owners of capital. If, however, the economy is saving at a rate consistent with the golden rule of accumulation, any business immigration will always benefit owners of capital at the expense of workers. In the long-run, the impact of business immigration on income distribution depends critically on the choice between the immigration rate and the saving rate as the control variable.

The present paper analyses business immigration in terms of the 'Pasinetti' phase of the Samuelson-Modigliani (S-M) (1966) neoclassical growth model incorporating a differential savings function. There are two reasons for doing this. First, the impacts of an event on an economy depend very much on the way the economy is modelled. The analysis would be incomplete if the alternative competing S-M model is not used to investigate the same issue. This is particularly important if the two models give different results, and conclusions based on the analysis of a particular model will fail to account for all possible events. This indeed is the case as we will show that under the

[1] Cf., Shea and Woodfield (1992).

S-M model, business immigration always hurts workers and benefits capitalists, a result different from that of the neoclassical model. However, under the golden rule of accumulation and optimal immigration policy, both models give identical results. One of the characteristics of the S-M model is that capitalists' savings propensity plays a dominant role in the analysis and that results are recursive. The second purpose of the paper is to investigate whether such a property still permeates the analysis in the presence of immigration.

The paper is organised as follows. Section II analyses optimal balanced growth immigration policy under exogenous savings rates for workers and capitalists, while Section III examines the effect of business immigration on optimal savings policy, and considers the problem of jointly optimal savings and immigration decisions of the host country. Comparisons with the results from the Solow-Swan neoclassical growth model with a proportional savings function are made at each stage. A conclusion completes the paper.

II. OPTIMAL BALANCED GROWTH IMMIGRATION POLICY

In this section, we generalize the Samuelson-Modigliani growth model to incorporate business immigration. We assume that each immigrant must be accompanied by a minimum amount of capital which can be interpreted as a 'price' of citizenship. This 'price' acts as a rationing mechanism for admission, but the ownership of the imported capital remains in the hands of the immigrant. Each immigrant is assumed to enter the labour force, and is equally productive as a native-born worker. Let the government admit immigrants equal to a given proportion γ of the labour force. The labour force growth rate is given by

$$\dot{L}/L = n+\gamma. \tag{1}$$

We model the amount of capital inflow accompanying business imigration by defining $g(\gamma)$ as the inverse demand function for business immigration, where $g'(\gamma) < 0$. The demand function is assumed to be time-invariant. If the capital requirement is $g(\gamma)$, there will be a continuous inflow of γL immigrants over time. Immigrants utilize all their available capital to obtain citizenship, and import all their available capital if admitted by the host country. Total capital inflow due to immigration is then $L\int_0^\gamma g(\gamma)d\gamma$.

With a differential saving function as specified by Pasinetti (1962), it is assumed that there exists two groups in society which save at different (but constant) rates. Capitalists save at a rate s_c from their income which solely comprises earnings from capital. Workers save at a rate s_w ($< s_c$) from their income, which comprises earnings from labour and earnings from their share of the capital stock. We assume that immigrants save at the same rate as 'native' workers. Let $f(k)$ denote the production function in intensive form, with $f' > 0$, and $f'' < 0$. Factor prices are assumed to reflect marginal products.

For capitalists, the rate of capital accumulation is given by s_cK_cf' where K_c denotes capital owned by capitalists. Dividing by K_c defines the growth rate of capital owned by capitalists, s_cf'. Subtracting the growth rate of the labour force $n + \gamma$ yields the proportionate growth rate of capitalists' capital owned per worker, $sf' - (n+\gamma)$. Multiplying by k_c, capitalists' capital per worker, yields the time rate of change of k_c as

$$\dot{k}_c = [s_cf' - (n+\gamma)]k_c. \tag{2}$$

Workers receive income $Lf - K_c f'$. Their rate of capital accumulation equals their savings $s_w(Lf-K_c f')$ plus capital inflows by business immigrant-workers, $L\int_0^{\gamma} g(\gamma)d\gamma$.

The corresponding time rate of change of workers' capital per worker is given by

$$\dot{k}_w = s_w(f-k_c f') - (n+\gamma)k_w + \int_0^{\gamma} g(\gamma)d\gamma. \tag{3}$$

Conditions for balanced growth require that the respective right-hand-sides of (2) and (3) vanish, i.e.

$$f'(k^*) = (n+\gamma)/s_c. \tag{4}$$

$$s_w f(k^*) + \int_0^{\gamma} g(\gamma)d\gamma = s_w k_c^* f'(k^*) + (n+\gamma)k_w^*. \tag{5}$$

Further, the sum of the resulting steady-state capital stock per worker for each group must equal the total capital stock per worker, i.e.

$$k_c^* + k_w^* = k^*.$$

The last three equations then determine the equilibrium values of k_c^*, k_W^* and k^*. Equation (4) will be recognized as the 'Cambridge Equation' in the presence of immigration, and states that the balanced growth marginal product of capital, and, hence, the long-run equilibrium rate of profit r^*, equals the sum of the natural growth rate and immigration rate divided by the saving rate of capitalists. Implicitly, (4) determines the economy's balanced growth capital intensity k^*. Clearly, workers' saving propensity does not affect the determination of k*, r*, or the long-run equilibrium wage rate $w^* = f(k^*) - k^*f'(k^*)$.

Substituting for $f'(k^*)$ from (4) into (5) and dividing throughout by s_w yields

$$f(k^*) + \left(\int_0^{\gamma} g(\gamma)d\gamma / s_w\right) = \frac{n+\gamma}{s_c}k_c^* + \frac{n+\gamma}{s_w}k_w^*. \tag{6}$$

From (6), workers' saving propensity s_w and per capita capital inflow $\int_0^{\gamma} g(\gamma)d\gamma$ in part determine the distribution of the total capital stock per worker k* between capitalists and workers (including immigrants) and, hence, the distribution of income between these groups. These factors, inter alia, determine whether or not the economy is in its Pasinetti phase or its dual phase, in which case $k_c^* = 0$ and capitalists are (relatively) extinguished.

To examine these issues, note that (6) along with the condition $k_c^* + k_w^* = k^*$ implies that

$$k_c^* = \frac{s_c}{(s_c - s_w)}\left[k^* - \frac{s_w f(k^*)}{n+\gamma} - \frac{\int_0^{\gamma} g(\gamma)d\gamma}{n+\gamma}\right],$$

$$k_w^* = \frac{s_w s_c f(k^*)}{(s_c - s_w)(n+\gamma)} - \frac{s_w k^*}{(s_c - s_w)} + \frac{s_c}{(s_c - s_w)(n+\gamma)}\int_0^{\gamma} g(\gamma)d\gamma. \tag{7}$$

To be in the Pasinetti phase requires $k_w^* > 0$. Using (7), the condition is

$$[(n+\gamma)/s_w]k^* > f(k^*) + \int_0^\gamma g(\gamma)d\gamma/s_w. \tag{8}$$

This condition can be interpreted graphically as follows.

FIGURE 1 about here

Consider Figure 1. In the presence of immigration, the balanced growth capital intensity in the Pasinetti phase is k*, corresponding to E, with $(n+\gamma)/s_c$ defining the slope of the tangent plane at E. TF intersects the ray OV_w at P, and the resulting perpendicular PQ partitions the Ok* interval into the ratio $k_w^* = k_c^*$. Note that

$$f(k) + \left(\int_0^\gamma g(\gamma)d\gamma/s_w\right) = \overline{Fk^*} = \overline{FN} + \overline{Nk^*} = \overline{FN} + \overline{PQ}.$$

Now,

$$\overline{FN} = \overline{PN}f'(k^*) = \overline{Qk^*}\frac{(n+\gamma)}{s_c}.$$

Also,

$$\overline{PQ} = \overline{0Q}\frac{(n+\gamma)}{s_w}.$$

So,

$$f(k^*) + \left(\int_0^\gamma g(\gamma)d\gamma/s_w\right) = \overline{Qk^*}\frac{(n+\gamma)}{s_c} + \overline{0Q}\frac{(n+\gamma)}{s_w},$$

as required for balanced growth. The Pasinetti phase requires that k* satisfies $f'(k^*) = (n+\gamma)/s_c$ and that the ray OV_w passes to the left of F.

(8) can be rewritten as

$$\frac{n}{s_w}k^* - f(k^*) > \frac{1}{s_w}\int_0^{\Upsilon} g(\gamma)d\gamma - \frac{\Upsilon}{s_w}k^*.$$

Compared with the case without immigration, the condition for the Pasinetti phase can be more or less stringent depending on whether $\int_0^{\Upsilon} g(\gamma)d\gamma - \gamma k^* \geq 0$, i.e., on whether the accompanying capital is sufficient to equip the immigrants up to the steady-state capital labour ratio. Note that if immigrants bring in enough capital to sustain the steady-state capital labour ratio for all workers (not just the immigrants), then capitalists' savings will no longer be required and they will be "driven out". The condition for this to happen is that

$$\int_0^{\Upsilon} g(\gamma)d\gamma > (\gamma + n)k^* - s_w f(k^*). \tag{9}$$

In the following analysis, unless specified otherwise, we always deal with the Pasinetti phase. The proposition below follows directly from (4).

PROPOSITION 1

Business immigration always reduces returns to workers and increases returns to capitalists.

Note that the impact on factor returns is independent of the amount of capital immigrants bring in and the immigration rate (unless it involves a switch of phase). The result is surprising as one would expect that the impact should depend on the immigration rate and the amount of capital immigrants bring in. Indeed that is the case under the neoclassical model. This reflects the characteristic of the S-M model that in the 'Pasinetti' phase, the steady-state equation for capitalists' capital per worker (i.e. equation (4)) alone determines the steady-state capital labour ratio. Thus, under the S-M model, labour unions should always act against business immigration. This is quite contrary to the common belief that business immigration can raise returns to workers as it brings additional capital into the economy.

To investigate optimal business immigration, notice that under the S-M model, there are a number of possible objective functions which one can maximize (see, for example, Woodfield (1981)). To make our results comparable to those of the neoclassical model, we will investigate the case where the objective is to maximize consumption per worker.

Consumption per worker equals output per worker less savings per worker. In balanced growth, the latter equals investment per worker less capital imports per worker. That is,

$$c = f(k^*) - (n+\gamma)k^* + \int_0^{\gamma} g(\gamma)d\gamma. \tag{10}$$

<u>PROPOSITION 2</u>:

The optimal capital requirement for business immigration is

$$g(\gamma^*) = k^* - \frac{(1-s_c)(n+\gamma^*)}{s_c^2 f''(k^*)}. \tag{11}$$

To establish Proposition (2), differentiate (10) with respect to γ and use (4) to simplify the resulting expression. A few remarks are in order. The optimal immigration rate depends on the saving behaviour of capitalists only and is independent of the saving behaviour of the workers, the characteristics of the S-M model. Under the neoclassical model, the optimal capital requirement is given by the condition $g(\gamma^{**}) = k^{**}$ and business immigration benefits workers. In contrast, under the S-M model, optimal immigration still hurts workers as a result of Proposition 1. Given the differential impact on factor returns, we know that k^{**} must exceed k^*. If $s_c < 1$, since $f'' < 0$, (11) shows that $\gamma^* \gtrless \gamma^{**}$. However, if $s_c = 1$, we can conclude that the optimal immigration rate is higher under the S-M model. It will be shown later that s_c will be equal to one under the golden rule of accumulation.

The optimal immigration policy depends on those structural parameters which serve to determine the steady-state capital labour ratio of the economy. Given the recursive nature of the Pasinetti solution, (4) shows these parameters to include s_c and n, but not s_w. Thus, $d\gamma^*/ds_w = 0$ and the optimal immigration policy is independent of workers' saving propensity. To examine the effect of a change in capitalists' saving rate on the optimal immigration rate, first differentiate (4) with respect to s_c, yielding

$$\frac{dk^*}{ds_c} = -\frac{(n+\gamma^*)}{s_c f''} > 0. \tag{12}$$

Differentiating the optimal capital requirement rule with respect to s_c yields

$$g' \frac{d\gamma^*}{ds_c} = \frac{dk^*}{ds_c} - \frac{d}{ds_c}\left[\frac{(1-s_c)(n+\gamma^*)}{s_c^2 f''(k^*)}\right].$$

Evaluating, and substituting for dk^*/ds_c from (12), yields

$$\frac{d\gamma^*}{ds_c} = \frac{(1-s_c)(n+\gamma^*)s_c}{\left(g' + \frac{1-s_c}{s_c^2 f''}\right)(s_c^2 f'')^2}\left[2f'' - \frac{\epsilon(n+\gamma^*)}{s_c}\right], \tag{13}$$

where $\epsilon \equiv f'''/f''$ is the elasticity of the rate of change of the rate of profit. If $s_c < 1$, the sign of (13) depends, in part, on the sign and magnitude of ϵ. The condition $\epsilon \geq 0$ is sufficient, but not necessary, for $d\gamma^*/ds_c$ to be positive, a result which contrasts with the Solow-Swan case where an increase in the (proportional) saving rate leads to an unambiguous decrease in the optimal immigration rate. For many neoclassical technologies, however, ϵ will be negative; for example, in the Cobb-Douglas case where $f(k) = k^\alpha$, $\epsilon = (\alpha-2)\, k < 0$. The general result is that

$$\frac{d\gamma*}{ds_c} \gtreqless 0 \text{ as } 2f'' - \frac{\epsilon(n+\gamma^*)}{s_c} \lesseqgtr 0. \tag{14}$$

Rather similar conclusions hold for a change in the natural growth rate. Differentiating (4) with respect to n yields

$$\frac{dk*}{dn} = \frac{1}{s_c f''} < 0. \tag{15}$$

Differentiating the optimal capital requirement rule with respect to n and substituting for dk*/dn from (15) yields

$$\frac{d\gamma^*}{dn} = \frac{1}{\left(g' + \frac{1-s_c}{s_c^2 f''}\right)s_c^2 f''}\left[-1 + \frac{(1-s_c)(n+\gamma^*)\epsilon}{s_c f''}\right]. \tag{16}$$

In the Solow-Swan model, an increase in the natural growth rate <u>reduces</u> the optimal immigration rate. For the Pasinetti phase, the same result requires that

$$\frac{d\gamma^*}{dn} < 0 \text{ as } \frac{(n+\gamma^*)\epsilon}{s_c f''} < \frac{1-2s_c}{1-s_c}. \tag{17}$$

III. GOLDEN RULE SAVINGS POLICIES

The results in Section II assumed exogenous saving rates for workers and capitalists. Suppose, however, that saving rates are determined according to the golden rule of accumulation. Since, from (4), the equilibrium capital labour ratio is independent of workers' propensity to save, maximizing per capita consumption requires choosing a saving rate for capitalists such that

$$\frac{dc}{ds_c} = [f' - (n+\gamma)]\frac{dk^*}{ds_c} = -[f' - (n+\gamma)]\frac{n}{s_c f''} = 0. \tag{18}$$

PROPOSITION 3:

The golden rule of accumulation implies that capitalists save their entire incomes.

To establish Proposition 3, note that for (18) to be satisfied, $f' = (n+\gamma)$. But from (4), $f' = (n+\gamma)/s_c$ across all steady states, so the golden rules requires $s_c = 1$, a result obtained by Sato (1966) for the Pasinetti phase in the absence of immigration. Hence, the golden rule of accumulation is independent of the presence of immigration, including immigration at the optimal rate. This result again illustrates the recursive nature of the solution to the Pasinetti phase.

More generally, if both saving rates of capitalists and immigration rates are chosen optimally, we would have

$$f'(\tilde{k}) = n + \tilde{\gamma}. \quad (19)$$

$$g(\tilde{\gamma}) = \tilde{k} \quad (20)$$

The same two equations characterize the economy under the golden rate of accumulation and optimal immigration in the neo-classical growth model. We thus have the following conclusion.

PROPOSITION 4:

Under the golden rule of accumulation and optimal immigration policy, the impacts of business immigration on the economy are the same under the S-M model and the neo-classical growth model.

Proposition 4 implies that the number of immigrants admitted, the equilibrium capital labour ratio and the returns to factors are the same under both models. In particular, both models predict that business immigration reduces returns to workers and increases returns to capitalists.

CONCLUSIONS

We have examined the long-run impacts of business immigration in the Pasinetti phase of the neoclassical growth model incorporating a differential savings function, and compared the results with those from the Solow-Swan-neoclassical model utilizing a proportional savings function. We show that the optimal capital requirement for business immigration is smaller than the steady-state capital labour ratio unless capitalists save all their income, a result required by the golden rule of accumulation, in which case the optimal capital requirement equals the equilibrium capital intensity. The latter result also characterizes the optimal capital requirement rule in the Solow-Swan model. In the Pasinetti phase, we show that any positive rate of business immigration raises the return to capital at the expense of the wage rate, so that unions interested in maximizing the wage should rationally oppose business immigration. This contrasts with the Solow-Swan model, for which unions should oppose any business immigration if a golden rule savings policy is in operation, but should support immigration if an optimal immigration policy is pursued.

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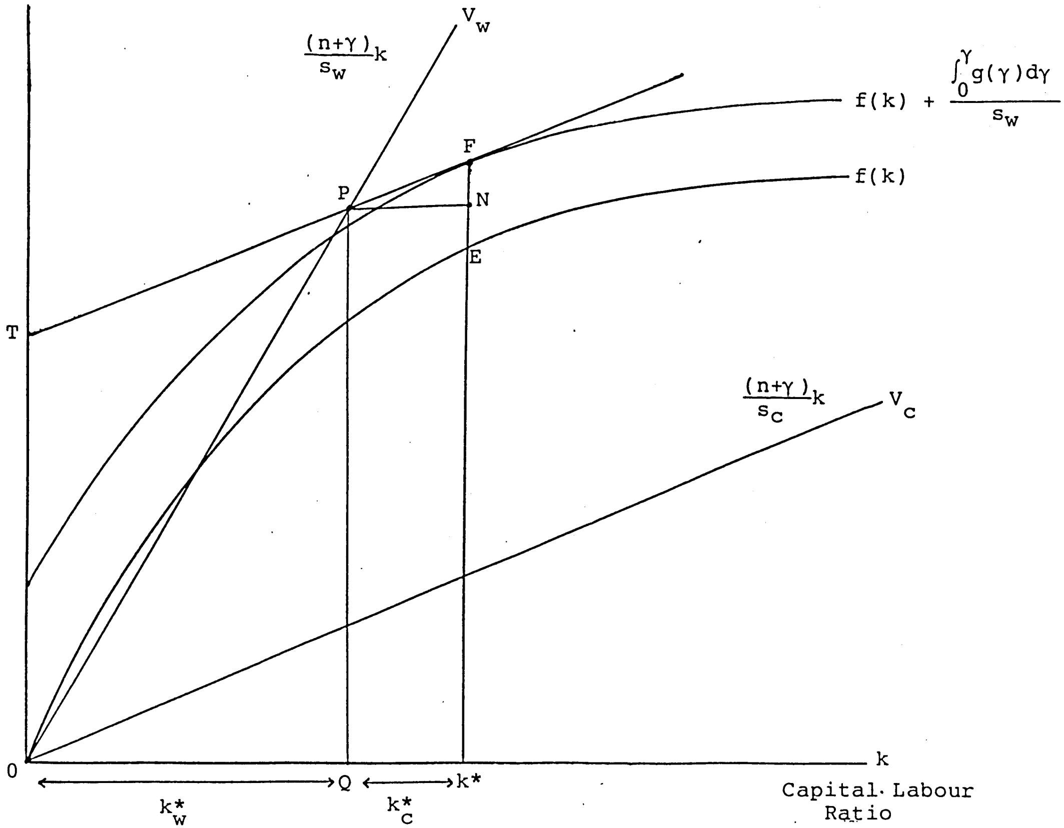
FIGURE 1: The Distribution of Equilibrium Capital per Worker Between Workers and Capitalists.



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