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MEASURING 1992's MEDIUM-TERM DYNAMIC EFFECTS

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ABSTRACT

This paper presents an explicit model of the link between the 1992 market liberalization and the aggregate marginal productivity of EC capital. We show that the liberalization is likely to lead to a ceteris paribus rise in capital's marginal product and thereby raise the steady-state capital-labor ratio. The comparative steady-state impact of 1992 on output is roughly quantified.

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This paper examines a source of medium–term dynamic gains from the 1992 program. The source of this effect is simple. A broad–based market liberalisation can increase the aggregate marginal productivity of capital. Consequently, in the Solow (1962) and Arrow (1962) growth models the liberalisation raises the steady–state capital–labor ratio. As the economy moves to its new steady–state, income rises more than the the static effect alone would imply. In this model the liberalisation does not change the long–run growth rate. It leads to a one–time upward shift of the path of output. The well–known static effect of a liberalisation has the same effect. What is new here is that the shift is larger, perhaps much larger, than the static effect alone would suggest. Baldwin (1989b) roughly quantifies this medium–term dynamic effect in a model with a constant savings rate. That paper finds that the medium–term dynamic effect could lead to an increase in EC output that is between 1.4 and 39 times greater than the static effects measured by the Cecchini Report. The current paper differs from Baldwin (1989b) in two ways. First, the link between the 1992 program and the marginal productivity of capital is explicitly modeled. Secondly, we attempt to roughly gauge the effect of 1992 on a country by country basis rather than for the EC as a whole. Baldwin (1989a) focuses on the welfare impact of the medium–term dynamic effect discussed here.

Other dynamic effects of trade liberalisations have been emphasised in the recent literature on trade and growth. The seminal theoretical papers in this effort are Grossman and Helpman (1988, 1989a, 1989b), Krugman (1988), and Murphy, Shleifer and Vishney (1988). These papers, which are part of the so–called new growth theory, demonstrate that one–time changes in trade policy can permanently affect a country's long–term growth rate. Clearly such dynamic effects have important implications for the 1992 program (Baldwin 1989b attempts to empirically measure such effects). It is important to note that the models in this paper are not part of the new growth theory.

Section 1 presents a simple example which highlights the basic logic of the dynamic gains addressed in this paper. Section 2 outlines the basic model. Section 3 characterises the steady–state balanced growth path. Section 4 does the same for a model from Baldwin (1989a) which allows for external economies of scale. Comparative steady–state analysis of a market liberalisation is done in Section 5. Section 6 attempts to roughly quantify the sise and timing of the medium–term dynamic effect of 1992. Section 7 contains a summary, concluding remarks and directions for further research.

1. A Simplistic Example

Suppose a country's gross domestic product (GDP) is related to its capital stock (K) and labor force (L) by:

$$Y_t = \beta K^{\alpha} L^{1-\alpha}.$$

Here β reflects the overall level of technology as well as the effects of trade barriers, regulations and other such "costs of non–Europe"; α is the captial output elasticity.

Investment is simply foregone consumption. The economy invests a constant fraction of GDP. The capital stock accumulates according to:

$$K_{t+1} = (1-\delta)K_t + \gamma Y_t$$

where δ is the rate of depreciation and γ is the constant investment—GDP ratio. The supply of labor is time invariant. The steady state in this economy is characterised by the K^s where:

$$\delta K^s = \gamma Y^s = \gamma \beta (K^s)^{\alpha} L^{1-\alpha}$$

Ignore for the moment the fact that the capital stock is endogenously determined. It has been estimated that 1992, by allowing a more efficient allocation of resources, will lead to a once—off rise in the EC's GDP of between 2.5 and 6.5 percent (Cecchini Report estimates). In other words, the same capital stock and labor force will produced 2.5 to 6.5 percent more output. In this simple example, the well—known static efficiency gain is submerged in the reduced form coefficient β; β therefore rises by 2.5 to 6.5 percent.

Clearly, in this example 1992 directly boosts the amount of investment in the economy. Consequently, the capital stock rises to a new steady—state level which is higher than the old one by exactly $1/(1-\alpha)$ times the percent rise in β. The total effect on output is therefore (using the convention that an "o" over any variable indicates a proportional rate of change, e.g., $\overset{o}{x} \equiv (x_{t+1}-x_t)/x_t$):

$$\overset{o}{Y^s} = \overset{o}{\beta} + \alpha \overset{o}{K^s} = \overset{o}{\beta} + \left(\frac{1}{(1/\alpha) - 1}\right) \overset{o}{\beta}.$$

Plainly income rises by more than the static efficiency gain. The extra gain due to this dynamic effect is $(\frac{\alpha}{1-\alpha})\overset{o}{\beta}$. This argument can be seen simply in Figure 1. This figure is simply the standard Solow model diagram. A once—off rise in static efficiency captured by a rise in β raises output per worker by more than the static effect. The total effect is broken down into the static effect, $(Y/L)'$ less $(Y/L)^{o}$, and the dynamic effect, $(Y/L)''$ less $(Y/L)'$.

A typical estimate of α (from growth accounting) is 0.25. This estimate of α implies that this indirect, dynamic effect is equal to one third of the static effect. As the capital–output elasticity approaches unity from below, the sise of this dynamic effect gets arbitraily large.

This simplistic example made two non–standard assumptions: (i) a constant investment–GDP ratio, and (ii) the static effects of 1992 can be captured by a proportional shift in the GDP function. The first assumption is reasonable if we restrict ourselves to steady–state, balanced growth paths (i.e., comparative steady–state analysis). The second hides an enormous amount of potentially important relative price effects. However, it is obvious that this assumption would be correct in a broad class of well–specified models (since the ad valorum tariff equivalent of many types of trade barriers enter multiplicatively in the first order conditions of firms). Below we present one such model.

2. The Basic Model

Since trade in goods is already substantially free within the EC, and the existing estimates of the costs of the remaining trade barriers are tiny (see "The Economics of 1992," by the EC Commision), we model the EC as a single goods market. Thus we intreprete the 1992 program as a general market liberalisation rather than concentrating on its trade liberalisation aspects.

Technology and Endowments

The economy is endowed with the same time–invariant supply of labor, L. There are N types of goods produced. All goods are produced according to identical technologies. In each period firms must incur a fixed labor costs (f units of labor) to be able to manufacture at all. If a firm does incur this costs, it can manufacture goods by combining capital and labor according to:

$$x_{it} = A_t (K_{it})^{\alpha} (L_{it})^{1-\alpha}$$

where x_{it} is a representative firm's output of good i in period t; K_{it} and L_{it} are the amounts of capital and labor employed by the firm (in addition to the f units of labor). A_t is the total factor productivity in the economy.

The next section allows A to be influenced by external economies of scale. Here total factor productivity is assumed to advance at a constant rate due to exogenous factors (say, human curiosity) as in the standard neoclassical growth model. Thus:

$$A_t = B_t, \text{ where } B_t = B_{t-1}(1+\iota).$$

The variable B represents the productivity effect of the level of basic scientific knowledge. When external economies are introduced the distinction between A and B becomes meaningful. Firms are assumed to take A_t and ι as given.

To stick as closely as possible to the Solow growth model, where investment is simply foregone consumption, we suppose that output can be transformed directly into capital. To make a unit of capital requires some of each of the N goods. Specifically, the gross amount of new capital created from output goods is $\prod_{i=1}^{N} (I_i)^{1/N}$ where I_i is the amount of good i that is used as an input in making capital goods. Again stay close to the Solow model, capital produced this period cannot be used until next period. Allowing this transform to require some factor inputs would not change the nature of the results.

Preferences

Consumers have identical preferences. The representative consumer's intertemporal preferences over the N goods is summarised by:

(1) $$U = \sum_{t=0}^{\infty} \left[\frac{1}{1+\rho}\right]^t \left(\frac{1}{1-(1/\sigma)}\right) \left[u(c_{1t},\ldots,c_{Nt})\right]^{1-(1/\sigma)},$$

where, $$u(c_{1t},\ldots,c_{Nt}) = \prod_{i=1}^{N} (c_{it})^{1/N}.$$

Here ρ is the constant discount rate, σ is the intertemporal elasticity of substitution and c_{it} is the consumption of good i in period t.

2.1 The Within Period Equilibrium

With this utility function and a perfect capital market, we can solve the consumer's between–period allocation problem independently of the within–period allocation problem. Taking as given that the representative consumer finds it optimal to set period t expenditure at E_t, his optimal within–period expenditure pattern is obviously to divide E_t equally among the N goods. Defining his income as Y_t, we have that his demand for new capital goods (which we assume is the only way to carry over income between periods) is $Y_t - E_t$. The consumption demand function for a typical good is:

$$c_{it} = (p_{it})^{-1}(E_t/N).$$

Additionally, the consumer's demand for new capital goods leads to an investment demand for each good:

$$I_{it} = (p_{it})^{-1}(Y_t - E_t)/N$$

The aggregate demand function, faced by firms, is the sum of these two demand curves.

Firms are price—takers in the factor markets. Firms play period—by—period Cournot in the goods market. The typical firm faces a series of static problems:

$$\max_{q_{it}, K_{it}, L_{it}} \; p_{it}q_{it} - w_t L_{it} - r_t K_{it} - w_t f, \text{ subject to}$$
$$q_{it} = x_{it}(1+\eta)^{-1} = A_t K_{it}^{\alpha} L_{it}^{1-\alpha}(1+\eta)^{-1}$$

where q_{it} is the representative firm's sales, x_{it} is its output, r is the rental rate on capital, w is the wage rate and p is the price of output. Here we have modeled what the EC Commission calls the costs of non—Europe as η. The whole gamut of small, "red tape" barriers, redundant regulation, X—inefficiencies, etc. are captured by η. For simplicity, we assume that η is not biased toward either capital or labor. Since η is meant to capture the effect of frictional barriers, it does not generate revenue or any kind of directly appropriable rents. It simply "melts" part of output. Its effect is therefore to drive a wedge between output and income.

Cost minimisation implies that firms operate with a capital—labor ratio (Ω) equal to:

$$(K_{it}/L_{it}) = \frac{w_t/(1-\alpha)}{r_t/\alpha} = \Omega_t.$$

Consequently the marginal cost, μ_t, is:

$$\mu_t = \frac{r_t\Omega_t + w_t}{A_t\Omega_t^{\alpha}}.$$

Since all sectors are symmetric, we drop the product index where clarity permits.

Firms play Cournot in output with the m other symmetric firms (m is determined by free entry) producing good i. The first order condition for a typical firm with respect to q_{it} can be written as:

(1) $$p_t(1 - \frac{1}{m}) = \mu_t (1+\eta).$$

The first order conditions with respect to capital and labor can be written as:

$$r_t = (\frac{\alpha}{K_{it}})(1 - \frac{1}{m}) A_t(K_{it})^{\alpha}(L_{it})^{1-\alpha}\left[\frac{1}{1+\eta}\right]$$

$$w_t = (\frac{1-\alpha}{L_{it}})(1 - \frac{1}{m}) A_t(K_{it})^{\alpha}(L_{it})^{1-\alpha}\left[\frac{1}{1+\eta}\right].$$

Solving these we find that the equilibrium output per firm is:

(2) $$\hat{x}_{it} = (\frac{Y_t}{Nm})(\frac{1 - (1/m)}{\mu_t(1+\eta)})$$

Ignoring the integer constraint, firms enter up to the point where m is such that the marginal firm's markup over marginal costs is just sufficient to cover the average fixed cost. This implies that the number of firm is the m which solves:

(3) $$m^2F_t = \left[1 + \eta(1-m)\right](Y_t/N)$$

if η is sero this simplifies to: $m = (Y_t/F_tN)^{1/2}$. It is easy to show that m rises as η falls. From the point of view of the model, the most important characteristic of m (apart from the fact that it exists) is how it changes over time. Recall that F_t equals w_t times f. Therefore if Y and w grow the same rate, the number of firms is time invariant. In the next section, we show that this is in fact the case.

Aggregating Across the N sectors

Aggregating over the firms' first order conditions with respect to capital and labor yields the income of labor and capital:

$$r_t K_t = \alpha \left(1 - \frac{1}{m}\right)\left[\frac{1}{1+\eta}\right] p_t X_t$$

(4)

$$w_t (L - mNf) = (1-\alpha)\left(1 - \frac{1}{m}\right)\left[\frac{1}{1+\eta}\right] p_t X_t ,$$

where $X_t \equiv \sum_{i=1}^{N} (m x_{it})$ and p_t is the common price of all varieties. We set this price equal to one, so all prices are measured in terms of units of output. Thus output is divided among rental income, wage income of labor employed in manufacturing, wage income of labor employed to meet the fixed costs, and the wastage due to τ and η.

Aggregate income, Y_t, is simply the sum of $w_t(L-mNf)$, $r_t K_t$ and $w_t mNf$. Aggregate investment measured in terms of output is $I_t = Y_t - C_t$, where $C_t \equiv \sum_{i=1}^{N} (c_{it})$. We also get an exact relationship between aggregate income, Y_t, the factors of production and technology:

(5)
$$Y_t = \beta A_t (K_t)^{\alpha} (L - mNf)^{1-\alpha}, \text{ where}$$

$$\beta \equiv \left[\frac{1}{1+\eta}\right].$$

Notice that as η falls to zero, β rises to one. Lastly, we have an exact capital accumulation equation:

$$K_t = K_{t-1} + \; (Y_{t-1} - C_{t-1}).$$

3. The Steady–State, Balanced Growth Path

Restricting our attention to steady–state, balanced growth paths, we know that consumption and output will grow a common rate, g^s. The intertemporal allocation of expenditure must therefore satisfy:

$$\text{(6)} \qquad \frac{\partial U/\partial C_t}{\partial U/\partial C_{t+1}} = (1+\rho)\left[\frac{C_{t+1}}{C_t}\right]^{1/\sigma} = (1+\rho)\left[1+g^s\right]^{1/\sigma} = (1+r^s)$$

where r^s is the steady–state real interest rate. If g^s is constant, r^s must also be constant. The constancy of r^s together with the aggregated first order condition with respect to capital implies that the capital–output ratio is constant on the steady–state path. Thus, $\overset{o}{K} = \overset{o}{Y} = g^s$. Using this fact in the aggregate Y function we see that:

$$\text{(7)} \qquad g^s \equiv \overset{o}{Y} = \overset{o}{A} + (\alpha)\,\overset{o}{K} = \left(\frac{1}{1-\alpha}\right)\iota$$

Note that the steady–state growth rate depends only on the capital–output elasticity, α, and the exogenous growth rate of basic science, ι. In particular it is not affected by policy as measured by η.

The capital accumulation equation together with the fact that investment must be proportional to income on the balanced, steady–state path implies that:

$$(8) \qquad \overset{o}{K} = \gamma^{s}(Y_t/K_t)$$

where γ^{s} is the factor of proportionality. The aggregate first order condition for K, together with (5) and (7) yields the steady–state capital–output ratio, χ^{s}. Thus:

$$(9) \qquad \gamma^{s} = g^{s}(\chi)^{s} = \alpha \frac{1-(1/m)}{r^{s}}\left(\frac{\iota}{1-\alpha}\right)$$

Thus the balanced, steady–state growth path is characterised by g^{s}, r^{s} and γ^{s}. From (2), it is easy to see that the growth of w is:

$$(10) \qquad \overset{o}{w}{}^{s} = \overset{o}{A} + \alpha \overset{o}{K}{}^{s} = \frac{\iota}{1-\alpha} = g^{s}.$$

This confirms that Y and w grow at the same rate so that the number of firms, m, is time–invariant.

The level of Y, C and I on the steady–state path are governed by:

$$(11) \qquad Y_t^{s} = \beta^{\left(\frac{1}{1-\alpha}\right)} B_t^{\left(\frac{1}{1-\alpha}\right)} (\chi^{s})^{\left(\frac{\alpha}{1-\alpha}\right)} (L-mNf),$$

$$(12) \qquad C_t^{s} = \gamma^{s} \beta^{\left(\frac{1}{1-\alpha}\right)} B_t^{\left(\frac{1}{1-\alpha}\right)} (\chi^{s})^{\left(\frac{\alpha}{1-\alpha}\right)} (L-mNf),$$

$$(13) \qquad I_t^{s} = (1-\gamma^{s}) \beta^{\left(\frac{1}{1-\alpha}\right)} B_t^{\left(\frac{1}{1-\alpha}\right)} (\chi^{s})^{\left(\frac{\alpha}{1-\alpha}\right)} (L-mNf),$$

where $B_t = B_{t-1}(1+\iota)$.

4. The Steady–State Growth Path With External Economies of Scale

Economies of scale that are external to the firm have played a role in trade theory since Adam Smith postulated that the division of labor is limited by the extent of the market. Their impact on growth was first analysed formally by Arrow (1962). More recently Romer (1983) has provided more detailed micro foundations for such externalities in a closed economy setting. Grossman and Helpman (1988, 1989a, 1989b) have done so in an open economy. In the context of our model, external economies would show up in the total factor productivity, A_t, which the firms take as given.

The true determinants of total factor productivity are not well understood. The traditional Solow model simply assumes that it rises due to exogenous technological progress. Denison (1985) and Maddison (1987), among others, have attempted to empirically explain the determinants of this exogenous technological progress in an ad hoc fashion. Much of the new growth theory can be interpreted as an attempt to endogenise growth by endogenising the growth of the A_t term. As such it emphasises things like profit–motivated innovation, technological spillovers, external economies of scales and the endogenous accumulation of human capital. The basic mechanism leading to the medium–term dynamic gains from trade demonstrated by this paper does not depend on the exact source of the productivity growth. Therefore rather than tie our model to a specific school of thought, we assume simply that:

(14) $$A_t = B_t K_t^{\theta} L^{\varphi}, \text{ where } B_t = B_{t-1}(1+\iota).$$

Again B represents the state of basic scientific knowledge, and ι is the exogenous rate at which this disembodied technology advances. As before, we assume that firms take A_t as given, even though their own choice of capital enters into the aggregate K_t. Grossman and Helpman's work shows us that in general a sector–specific liberalisation may change the extent of aggregate external scale economies by helping or hindering the sector which is marked by the largest external effects. Thus in many instances, assuming (14) submerges an important effect. Such theoretical refinements are important subjects for future research; however this paper is intended to show that there are easily measurable dynamic gains from trade even in the simplest growth models.

There are several possible interpretations of equation (14). The most straightforward is that $K^{\theta}L^{\varphi}$ represents the standard external economies of scale. That is the output of any one firm depends on the overall level of output as well as the level of its inputs. Thus the firm–level production function is: $x_i = Y^{\psi}K_i^{\alpha}L_i^{1-\alpha}$, where ψ is a measure of the external scale economies. In this case, θ is such that $\alpha+\theta$ equals $\alpha/(1-\psi)$ and φ is such that $1-\alpha+\varphi$ equals $(1-\alpha)/(1-\psi)$. Alternatively, Romer (1987) argues that there is no exogenous disembodied technological progress, all technology is embodied in capital and technological spillovers among firms is important. Thus external economies are entirely captured by K^{θ}, and ι and φ are zero. Arrow (1962) only requires that $\alpha+\theta$ is less than unity. Lastly the Solow model is where θ and φ equal zero (as in the previous section).

Steady–State Growth Path

The equations in the previous section which describe the within period equilibrium are unaltered by the inclusion of external economies since firms individually take A_t as given. The relationship between g^s and ι, however, is changed. Avoiding repetition, we skip straight to the determinants of the steady–state growth path. As before the steady–state interest rate will be constant. The firm's optimal choice of K/Y will therefore be constant. Consequently, K and Y must grow together. However, now the aggregate Y function is:

$$Y_t = B_t\,\beta\,(K_t)^{\alpha+\theta}\,(L-mNf)^{\varphi+1-\alpha}. \tag{15}$$

The advancement of basic science, B, raises total factor productivity more than proportionally due to the economies of scale, so:

$$g^s \equiv \overset{o}{Y} = \overset{o}{B} + (\alpha+\theta)\,\overset{o}{K} = \left(\frac{\iota}{1-\alpha-\theta}\right). \tag{16}$$

The new levels of Y, C and I on the steady–state path are governed by:

$$Y^s_t = \beta^{\left(\frac{1}{1-\alpha-\theta}\right)}\,B_t^{\left(\frac{1}{1-\alpha-\theta}\right)}\,(\chi^s)^{\left(\frac{\alpha+\theta}{1-\alpha-\theta}\right)}\,(L-mNf)^{\left(\frac{1-\alpha+\varphi}{1-\alpha-\theta}\right)}, \tag{17}$$

$$C^s_t = \gamma^s\,\beta^{\left(\frac{1}{1-\alpha-\theta}\right)}\,B_t^{\left(\frac{1}{1-\alpha-\theta}\right)}\,(\chi^s)^{\left(\frac{\alpha+\theta}{1-\alpha-\theta}\right)}\,(L-mNf)^{\left(\frac{1-\alpha+\varphi}{1-\alpha-\theta}\right)}, \tag{18}$$

$$I^s_t = (1-\gamma^s)\,\beta^{\left(\frac{1}{1-\alpha-\theta}\right)}\,B_t^{\left(\frac{1}{1-\alpha-\theta}\right)}\,(\chi^s)^{\left(\frac{\alpha+\theta}{1-\alpha-\theta}\right)}\,(L-mNf)^{\left(\frac{1-\alpha+\varphi}{1-\alpha-\theta}\right)}. \tag{19}$$

5. 1992 and the Comparative Steady–State Analysis

The 1992 program will generally liberalise the EC. This sort of liberalisation yields a static efficiency gain which is relatively straightforward to measure. Empirical studies of the GDP–boosting impact of liberalisations ignore the dynamic effects on the steady–state capital stock. Consequently, these studies predict that the income and consumption paths will be raised only by the static effect. In our model this static effect is equivalent to:

$$\overset{o}{Y}_{static} = \overset{o}{\beta} - (1-\alpha+\varphi)\left(\frac{mNF}{L - mNF}\right)\overset{o}{m} \tag{20}$$

where $\overset{\circ}{\beta}$ and $\overset{\circ}{m}$ both rise as η falls due to the liberalisation. The exact link between $\overset{\circ}{\beta}$, $\overset{\circ}{m}$ and η follows directly from (3) and (5). The Cecchini Report estimates that this static effect will raise EC GDP by between 2.5 and 6.5 percent. We take this as an estimate of $\overset{\circ}{Y}_{static}$.

Changes in η obviously affects the rate of return on capital. Therefore 1992 will lead consumers to postpone consumption in order to take advantage of the higher rate of return. The resulting accumulation of capital will eventually push the rate of return back to the steady–state level. However the economy will now be on a higher path. More importantly, the upward shift in the path will be greater than the size of the static effect given in (20). The new level of the steady–state path can be found from (11) for the Solow model and (17) for the Arrow model. Namely, the percent difference between Y_t on the post– and pre–liberalisation steady–state paths is:

$$(21) \qquad \overset{\circ}{Y}{}^{s}_{t} = \left[1 + \left(\frac{1}{\frac{1}{\alpha+\theta} - 1}\right)\right] \left(\overset{\circ}{\beta} - (1-\alpha+\varphi)\left(\frac{mNF}{L - mNF}\right)\overset{\circ}{m}\right).$$

$$= \left[1 + \left(\frac{1}{\frac{1}{\alpha+\theta} - 1}\right)\right] \overset{\circ}{Y}_{static}$$

The total effect is the static effect plus the indirect effect on the steady–state capital stock. The second term in the large parentheses is the medium–term dynamic gain from trade. If we set θ equal to zero, (21) defines the dynamic gain in the Solow model. If we allow it to be positive, but still small enough such that $\alpha+\theta$ is less than one, (21) defines the dynamic gain in the Arrow model. Baldwin (1989b) considers the case where $\alpha+\theta$ is greater than or equal to unity.

6. Measuring One Type of the Dynamic Gains From Trade

Clearly it is extremely simple to measure the size of this dynamic effect. Indeed, only two readily available estimates are required. The true capital output elasticity of the GDP function, $\alpha+\theta$, and an estimate of the size of the static gain. We shall use the Cecchini Report's range of 2.5 to 6.5 percent for the latter.

The size of $\alpha+\theta$ is an important but unsettled empirical question. Prior to the emergence of the new growth literature, it was widely assumed that $\alpha+\theta$ was equal to capital's share of income. (This is an implication of perfect competition and constant returns to scale much exploited by the growth accounting literature.) Table 1 reproduces a number of such estimates for France, Germany, the Netherlands and the UK. These estimates were taken from growth accounting studies. The numbers range from 0.446 to 0.222. A recent study, Maddison (1987), takes 0.3 as the consensus figure.

A number of researchers have attempted econometric estimation of the sum of the capital and labor output elasticities using industry data. This is widely interpreted as a measure of aggregate scale economies. Caballero and Lyons (1989) have done so for France, Germany, Belgium and the UK. To recover what we call $\alpha+\theta$ from the Caballero and Lyons numbers, we multiply their aggregate number by capital's cost share. Since in fact these authors use panel data on capital's cost share, it is not possible to recover the exact number we need. Nevertheless, we get a rough approximation by multiplying the Caballero and Lyon's aggregate number by Maddison's consensus 0.3. Also since their estimates are rather imprecise we do the same calculation for their points estimates plus one standard error and minus one standard error. The resulting numbers are listed in Table 1.

Equation (21) shows that the extra rise in GDP due to the indirect effect depends only on $\alpha+\theta$. We can think of this number, $(\alpha+\theta)/(1-\alpha-\theta)$, as a multiplier on the static gain. The size of this multiplier can by itself tell us how important the indirect, dynamic effect is. For instance take the low estimate of $\alpha+\theta$ for France from Table 1, 0.23. To get the total effect on GDP, we must multiply the static effect times one plus the multiplier. In this case the multiplier equals about 0.3. (That is $(\alpha+\theta)/(1-\alpha-\theta)$ taking $\alpha+\theta$ equal to 0.23.) In other words for France, by ignoring the fact that the capital stock is endogenously determined, empirical estimates of the static effect alone underestimates the total effect by at least 30 percent. Table 2 presents the values of the multipliers that correspond to the high and low values of $\alpha+\theta$ from Table 1 for each country.

To get estimates of this dynamic gains from 1992, we multiply the static effect by the various estimates of the multiplier. The results are listed in Table 3. To reduce needless repetition, we have taken the high and low estimates of the multiplier for each country from Table 2, and multiplied these by the high and low estimates of the static effect from the Cecchini Report (2.5 to 6.5 percent). The first row in Table 3 presents 1992's effect on EC GDP (in percentage points) due solely to the indirect effect. Of course there would be no indirect effect without the static gain, so the total effect (the static range of 2.5 to 6.5 plus the high and low ranges from the first row) of 1992 on EC GDP is presented in the second row of Table 3.

The most robust conclusion from Table 3 is that in all cases the indirect effect is considerable. At the very least it means the endogenous rise in capital will boost EC GDP by an extra 0.6 percent. The largest numbers in this table are large by comparison with the Cecchini Report range. They are all about twice the size of the high end of the Cecchini Report range (Belgium's is four times larger).

Baldwin (1989b) attempts to establish an upper bound on this type of gain by using an ordinary least squares (OLS) estimate of the GDP function. The OLS estimate of $\alpha+\theta$ is 0.975. This value of $\alpha+\theta$ yields a multiplier of 38.

6. Summary and Conclusion and Further Research

This paper attempts to exposit and measure one type of dynamic gains from the 1992 program. The basic source of the dynamic gain is simple. The rise in overall EC efficiency due to 1992 will raise the marginal product of capital in the EC. This in turn will lead to an endogenous rise in the steady—state capital stock. Output, therefore, rises more than the static effect.

Two conclusions emerge. (1) This type of dynamic gain —— which is based on well—accepted growth models (Solow 1962, Arrow 1962) —— is very easy to measure. Moreover the size of the effect is large compared with the static effects usually measured. We find that it amounts to between 30 and 136 percent of the static effect. In other words, by ignoring this dynamic effect, existing empirical estimates of the rise in EC GDP due to 1992 are between 30 and 136 percent too small. (2) We find that 1992 will raise EC GDP between 3.1 and 25.4 percent. The imprecision of this range is due primarily to the imprecison of our knowledge of the true aggregate output elasticity of capital.

This paper suggests that further work be done on estimating the aggregate capital—output elasticity. This is not an easy task (see Caballero and Lyons 1989a,b). From the theory standpoint, the basic lessons of Grossman and Helpman (1989a, b) need to be integrated. Essentially due to the strong symmetry, the liberalisation has no effect on the relative prices of goods. This approach may be somewhat justified in analysing a program that is as broad—based as 1992. However in general, a liberalisation changes relative prices. As a result, the marginal product of capital rises in some sectors and may fall in others. Indeed it is well known that if the external economies are strongest in the contracting sectors, GDP might actually fall. Perhaps most important of all is to derive the welfare implications as in Grossman and Helpman (1989c).

Finally, the dynamic gains from liberalisation presented in this paper is based on the simple observation that the capital stock is endogenous. This simple observation has many implications for traditional trade theory which takes capital as a fixed factor. Baldwin (1989c) shows that the Stopler—Samuelson theorem is incorrect in an dynamic 2—by—2 trade model. A tariff which favors production of the capital intense goods leads to a rise in the return on capital and a fall in the wage in a static 2—by—2 model. In a dynamic model, the rise in the rental rate endogenously raises the capital stock. In the Solow or Arrow models, where steady—state growth is technologically determined, captial accumulates up to the point where the rental rate returns to its old level. Thus in the long—run, capital never "loses" and labor always "wins" from a trade liberalisation. In a model with endogenous growth, the Stolper—Samualson result is softened. The liberalisation leads to somewhat faster growth and a somewhat higher rental rate. Of course, in the short—run the standard Stopler—Samuelson result holds.

FOOTNOTES

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Table 1: Estimates of $\alpha+\theta$:

Source	France	Germany	Netherlands	UK	Belgium
Denison (1967) Denison and Chung (1976)	.23	.263	.26	.222	
Maddison (1987)	.305	.3	.296	.255	
Kendrick (1981)	.382	.349		.348	
Christensen Cummins and Jorgenson (1980)	.403	.386	.446	.385	
Caballero and Lyons (1989)	.366	.477		.339	.426
Minus one Std Error	.288	.39		.195	.276
Plus one Std Error	.444	.564		.483	.576

Source: First four rows reproduced from Maddison (1987), Table 8.
Fifth row reproduced from Caballero and Lyons (1989).

Table 2: Underestimate of GDP Rise by Ignoring Indirect Effect
(Percent)

	France	Germany	Netherlands	UK	Belgium
Lo	30	36	35	24	38
Hi	80	129	124	93	136

Source: Author's calculation.
The underestimate is $(\alpha+\theta)/(1-\alpha-\theta)$.

Table 3: Estimated Increase in GDP due to 1992

Indirect Effect on GDP due to rise in Steady–State Capital Stock
(Percentage Points to be Added to Static Range)

$\alpha+\theta$	France	Germany	Netherlands	UK	Belgium
Lo	.8 to 2	.9 to 2.3	.9 to 2.3	.6 to 1.6	1 to 2.5
Hi	2 to 5.2	3.2 to 8.4	3.1 to 8.1	2.3 to 6	3.4 to 8.9
			Total Effect (Static plus Dynamic) (Percent rise in GDP due to 1992)		
Lo	3.3 to 8.5	3.4 to 8.8	3.4 to 8.8	3.1 to 8.1	3.5 to 9
Hi	4.5 to 11.7	5.7 to 14.9	5.6 to 14.2	5.8 to 12.5	5.9 to 25.4

Source: Author's calculation.

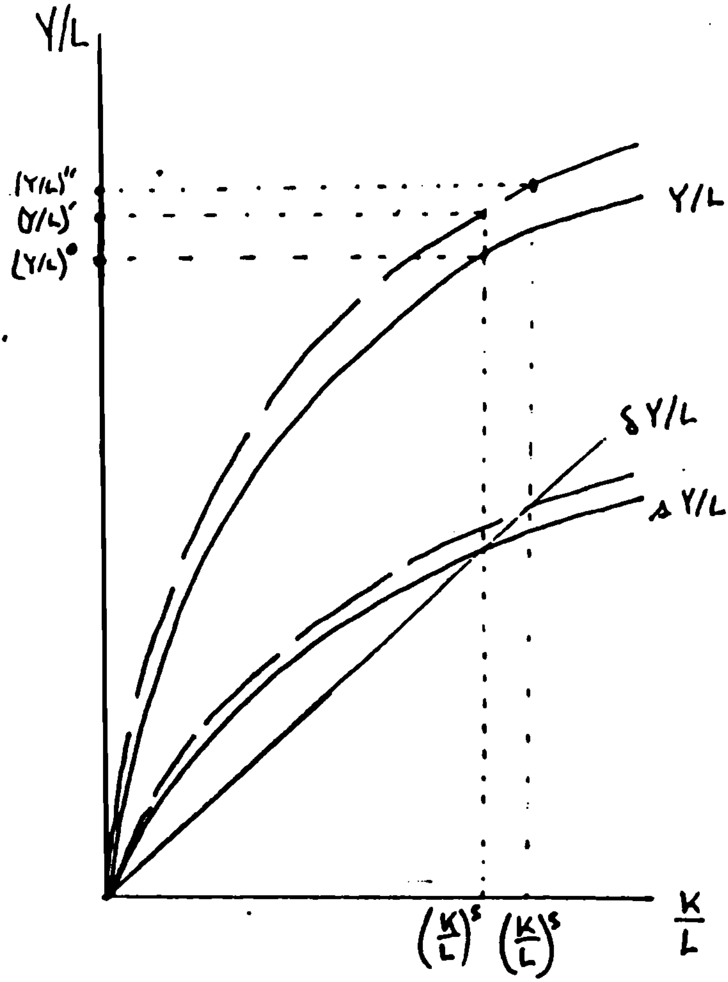

Figure 1