MACROECONOMIC GAINS FROM LIBERALISING FOREIGN INVESTMENT IN APEC

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Abstract
This paper analyses the macroeconomic gains to Asia-Pacific economies from liberalising foreign investment flows. It first presents an intertemporal theoretical framework to convey, in principle, how higher national income stems from the narrowing of the gap between domestic and foreign rates of return on capital. Using a computable general equilibrium model it then empirically quantifies the impact on investment, the capital stocks, the external accounts and national income of a one percentage point reduction of the rate of return on capital due to further liberalisation of impediments to foreign investment. The results show national income gains for Asia-Pacific economies are on average around 0.3 percent per annum, which compounded through time implies significant long-term improvement in living standards in the region. This suggests APEC should afford greater priority to foreign investment liberalisation.

Keywords: APEC, capital flows, general equilibrium, macroeconomic gains, multinational firms.

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1. Introduction

The Asia-Pacific region has driven world economic growth since the 2008-09 Global Financial Crisis with the region’s main economic grouping, Asia Pacific Economic Co-operation (APEC), producing 60 per cent of global GDP covering 40 per cent of the world’s population, some 2.9 billion people. Founded over three decades ago, APEC’s 21 member economies encompass a diverse range of advanced and emerging economies, including the world’s three largest, the United States, China and Japan, as well as Australia, Brunei, Canada, Chile, Hong Kong, Indonesia, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, The Philippines, Russia, Singapore, Republic of Korea, Chinese Taipei, Thailand, and Viet Nam.

Over the past thirty years the APEC economy has almost trebled, and average incomes more than doubled. Extreme poverty has been drastically reduced, due mainly to hundreds of millions of Chinese benefiting from astounding economic growth rates. Expansion of international trade in goods and services is widely credited for boosting Asia-Pacific growth. Trade in goods and services over this time expanded at an annual average 7.1 per cent nearly twice as fast as GDP growth at an annual average 3.7 per cent. However, since 2012 international trade growth in the region has slowed, corresponding more closely with GDP growth. (See APEC 2019).

The scale of international trade flows in Asia far exceeds cross-border investment flows in the form of FDI according to the latest United Nations Conference on Trade and Development (UNCTAD) data. For Asia, total FDI, inward and outward, has ranged between a mere 5 to 8 per cent of total trade in goods and services, exports plus imports. See Figure 1.
Although UNCTAD’s Asia grouping excludes American and Oceania APEC members, it is nonetheless indicative of the huge difference between trade and FDI flows in the broader Asia-Pacific region. This difference suggests regulatory and ‘behind-the-border’ barriers are severely limiting FDI. To the extent these barriers are discouraging cross-border investment flows, growth in APEC is therefore potentially sub-optimal, begging the question of how much better off the Asia-Pacific would be if FDI was liberalised.

Historically, the theoretical and empirical international economics literature has mainly focused on the gains from liberalising international trade in goods and services, rather than liberalising foreign investment flows, particularly in the form of foreign direct investment (FDI) which involves lasting acquisition of foreign assets and a degree of control over their use in production.\(^1\) The role FDI has played and its potential for boosting future economic growth

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1. This is reflected in the much heavier emphasis on international trade theory relative to foreign investment theory in popular international economics textbooks. See for instance Carbaugh (2017), Feenstra and Taylor (2018) Krugman and Obstfeld (2018), and Salvatore (2015).
A sizeable theoretical literature has evolved espousing the economic benefits of liberalising FDI, although it is focused predominantly at the microeconomic or industry level. In summary, the main lesson from this literature is that FDI channelled into industries through multinational corporations improves economic welfare in host economies via new product development and technology transfer, by spurring imitative behaviour and management practices in domestic enterprises, as well as by enhancing competition in local goods and services markets. (See Caves 1971, Carr et al 2001, Helpman 2006, Markusen 2002, Razin and Sadka 2007, Moran 2012 and Paul et al 2020).

At the macroeconomic level, a comparatively small literature suggests that when FDI flows to economies in pursuit of a higher rate of return, the domestic capital stock of the host economy’s rises, allowing higher national income, net of income paid abroad. National income simultaneously rises in FDI source economies if the rate of return on their capital invested abroad exceeds that at home. (See McDougall 1960, Lucas 1990).

Meanwhile, intertemporal models incorporating international capital flows focus mainly on international borrowing and lending (officially classified as indirect, or portfolio, foreign investment) rather than FDI per se. (See inter alia Frenkel and Razin,1987, Obstfeld and Rogoff 1996). This micro-founded macroeconomic perspective shows such flows raise intertemporal national income, consumption, and hence living standards, although neglects to acknowledge that FDI itself can improve a host economy’s productivity, as suggested in the above referenced industry-oriented literature.

Empirically, various econometric techniques have been applied to test the magnitude of the economic benefits of FDI for a range of countries and regions yielding mixed results. See inter

In preview, based on theory and empirical evidence this paper argues that abolishing restrictions impeding FDI would deliver significant macroeconomic gains for economies in the region. The next section presents an intertemporal theoretical framework to convey, in principle, how higher national income stems from the narrowing of the gap between domestic and foreign rates of return on capital. Section 3 then outlines the foundations of a computable general equilibrium model used to gauge the effects of liberalising foreign investment in APEC economies. Section 4 quantifies the impact on investment, capital stocks, the external accounts and national income of a one percent lowering of the rate of return on capital due to further liberalisation of impediments to foreign investment. Section 5 concludes the paper by arguing that APEC should afford greater priority to foreign investment liberalisation.

2. The International Macroeconomics of FDI

In a two-sector closed economy, comprised of resident households and firms, firms combine labour, land, and capital and given technology to produce maximum output in the present and future. Meanwhile, households supply labour and have utility preferences for present consumption ($C_p$) and future consumption ($C_f$). Assuming a stable price level, an investment opportunities function ($\rho$) converts present domestic saving, $S_p$, (national income less consumption) into future real output ($Y_f$) via an intertemporal production function of the form $Y_f = Y_p (K, L) + \rho(I_1)$ where $I_1$ is firms’ net investment.
2.1 Capital Autarky

The economy’s problem is to maximise its consumption, or living standards (l) intertemporally, given available factor endowments and investment opportunities. The present values of the future stream of national output (Y_t) and consumption (C_t) are \( Y_t / (1 + ROR) \) and \( C_t / (1 + ROR) \) where ROR is the rate of return on capital reflected in the prevailing domestic interest rate. The output of firms over both periods, F(Y_1, Y_2) is maximised subject to the solvency condition that income earned in the present and the future discounted to its present value is sufficient to cover households’ intertemporal consumption. That is,

\[
Y_p + \frac{Y_f}{1 + ROR} = C_p + \frac{C_f}{1 + ROR}. \tag{1}
\]

The international macroeconomic approach to capital flows following Fisher (1930) found in, inter alia, Frenkel and Razin (1996) and Obstfeld and Rogoff (1996) usefully conveys the potential macroeconomic gains from liberalising foreign borrowing and lending. However, with its focus on portfolio, or indirect, foreign investment, it neglects the productivity benefits that the microeconomics literature identifies as accruing from FDI. In the following exposition we therefore extend the basic Fisherian framework to reflect FDI’s impact on a host economy’s productivity by comparing capital autarky and liberalised foreign investment equilibria.

Figure 2 depicts present period macroeconomic variables, GDP, income, consumption, saving and investment on the horizontal axis and counterpart future values of these variables on the vertical axis. This figure shows that combining the economy’s given factor inputs yields an initial level of ‘endowed’ output of \( Y_p \) and that, ceteris paribus, in real present value terms, this would also be its future value, \( Y_f \) as mapped into the future by the 45° line OW. With capital autarky, domestic saving enables additional investment and hence larger capital stock that generates higher future GDP and national income.
In Figure 2 this is conveyed by the Fisherian investment opportunities frontier (IOF) with its origin at W that reveals domestic firms' capacity to transform present saving and investment into additional GDP in the future. Movement up leftward along the IOF from point W implies expansion of the domestic capital stock, whose marginal product diminishes for given labour and technology. If FDI is prohibited, general equilibrium occurs at point E, the point of tangency between the investment opportunities frontier and community indifference curve.

Figure 2 - Macroeconomic Welfare Gains from Liberalising FDI
At point E the marginal rate of transformation of present into future income (\(MRT\)) in the capital autarky case equals the marginal rate of substitution of present for future consumption (\(MRS\)). Or,

\[ MRS = MRT = 1 + ROR \quad . \]  

(2)

Hence in a closed economy, households’ rate of time preference equals the rate of return on the domestically owned capital stock.\(^2\)

\[2\] Liberalising FDI

Now assume the economy has unrealised investment opportunities and that to allow their exploitation, the government abolishes restrictions limiting FDI. With deregulated FDI foreign investors are free to realise new investment opportunities using alternative knowhow and practices. This shifts the IOF out, as shown in Figure 2, raising the productivity of capital in use in the economy, with equilibrium shifting from point E to point E’. Domestic capital formation increases from \(I_p\) to \(I_p’\) in the present period, generating a capital account surplus in the external accounts of distance FI because the correspondence between present domestic saving and investment no longer holds, as it must in autarky.

The equilibrium rate of return on capital falls as foreign investment rises, reflected in the flatter tangency line. The equilibrium optimising condition therefore becomes

\[ MRS = MRT = 1 + ROR^* \quad . \]  

(3)

The difference between the rate of return under capital autarky and that under unrestricted foreign investment (\(ROR – ROR^*\)) is effectively a shadow tax. This shadow tax arises from the barriers to foreign investment that prevent arbitrage of discrepant cross-border rates of return. In addition, these barriers impose further deadweight losses on host economies to the extent they deny them the national income gains from FDI related productivity improvement.

\[^2\] See Makin (2004) for a formal derivation.
Macroeconomic welfare is unambiguously improved intertemporally following FDI deregulation as higher future GDP affords higher future consumption (distance $\Delta C_f$), as well as higher present consumption (distance $\Delta C_p$). The variation in present consumption reflects higher future income making present consumption more affordable, reinforced by a lower rate of return on capital making current consumption less expensive relative to future consumption. Importantly, source economies also experience higher national income and hence consumption compared to the autarky case. In Figure 2 additional future income generated by FDI for the source economy is the product of the new equilibrium rate of return and the quantum of foreign investment in the present. In the future, this equates to income paid abroad by the host economy that must be subtracted from the host economy’s future national output (GDP) to yield its future national income.

3. A Global Computable General Equilibrium Model

Having made a theoretical case for liberalising FDI, we now aim to test the predictions of the theory using a computable general equilibrium (CGE) framework for APEC economies. The defining characteristic of CGE models is their comprehensive representation of the economy. Thus, the economy comprises various components or agents that interact and are interdependent. The representation is comprehensive because together these components capture the sum total of economic activity in an economy. A CGE model can represent the economy of a single country (e.g., Dixon et al., 1982) or many countries (e.g., Hertel, 1997).

The comprehensive representation of an economy means CGE models can be very large compared to partial equilibrium models. However, they also provide a wide array of policy levers (i.e., model variables) with which to simulate changes in an economy. This includes technology, taxes, preferences, saving rates and stock-flow relationships between investment
and capital stocks, government deficits and government debt, current account deficits and net foreign liabilities.

The CGE model applied here is a dynamic multi-country model of the global economy. It represents the supply and demand side of commodity and factor markets in each region (i.e., country or country-grouping). Each region contains a range of representative agents. There are six domestic producers and six foreign producers in each region, each producing one commodity. Commodities can be consumed domestically or exported to other regions. There is a physical capital creator and investor for each industry. There is a single representative household in each region that owns all factors of production and thus receives all factor income (net of taxes): households can either spend or save their income. There is also a single government sector in each region. Foreigners supply imports to each region at variable c.i.f. prices and demand commodities (exports) from each region at variable f.o.b. prices. The import and export prices reflect market-clearing outcomes.

Below we first briefly describe the structure of the model before applying it to data in the next section. A more formal presentation of the model’s micro-foundations appears in Appendix 1. The model represents the APEC region within a CGE framework with a focus on FDI, with multinational companies differentiated by region of ownership, global foreign affiliate data, and portfolio investment.3

3.1 Production Technology

The model distinguishes representative multinational firms and hence production by location and owner. Each representative firm is assumed to treat the factors of production (labour and physical capital) and intermediate inputs (of which there six) as variable and take factor prices

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3 The model is implemented and solved using the GEMPACK economic modelling software (Harrison and Pearson, 1996).
as given in minimising costs. Demands for primary factors and intermediate inputs are modelled using nested production functions. At the top level, a firm’s activity is determined as a CES combination of the primary factor composite (an aggregate of land, labour and capital) and the six composite intermediate inputs using CES production technology.

At the second level, firms combine the three factors of production using CES production technology. At level three, firms determine composite intermediate inputs by combining domestic and imported intermediate inputs using CES production technology. All firms are assumed to operate in perfectly competitive markets and so a zero-pure-profits condition is imposed that equates revenues with costs.

3.2 Market Clearing

The supply price for an industry is linked to the market price inclusive of an output tax. The market price is determined via a market-clearing condition where the aggregate of domestic sales (to firms, capital creators, households and government) and export sales to the nine destinations equals total output. Total domestic sales by domestic firms and multinationals are combined to form a CES composite. Total imports of the six goods in each region is a CES composite of exports from all export sources.

3.3 Investment and Capital Accumulation

It is assumed there is a single capital good used by all firms in each industry. Investment by the industry is determined as a positive function of the post-income-tax, net-of-depreciation rate of return on industry capital. During a simulation the rate of return fluctuates in the short run. However, it returns to its initial value in the long run by making investment in year $t$ a positive function of the rate of return in year $t$. Inputs to investment are a CES composite of imported and domestic inputs to investment. Capital creators are assumed to operate in
perfectly competitive markets, hence a zero-pure-profits condition is imposed equating revenues with costs.

All firms in an industry use capital specific to their industry. An industry’s capital stock for use in year $t$ equals its capital at the start of year $t-1$ less any capital depreciation during year $t-1$ plus investment during year $t-1$. For each type of capital, there is an industry-specific rental rate determined by a market-clearing condition. Given industry capital stocks, the movement of capital between owners (foreign and domestic) in each industry is determined by a CET function.

We define a market-clearing condition for capital that sets a common rental price of capital for all owners of capital in an industry. Thus, any change that lowers the price of capital for any supplier of capital in a given industry will reduce the price of capital for all owners of capital in that industry. Consistent with this treatment of rental prices by industry, in the initial data we set net rates of return to capital equal across all suppliers of capital to a regional industry. Thus, rates of return vary across industries within a region, but do not vary across owners of capital within the same industry in a region.

3.4 Household and Government Consumption

The consumer’s utility function in each region is a CES combination of leisure ($N$) and consumption ($C$). The consumer’s budget constraint requires that the post-tax value of the labour endowment ($W.H$) plus post-tax value of non-labour income ($NLY$) should equal expenditure on consumption ($P.C$) and leisure ($W.N$). Here leisure is valued at the post-tax wage rate ($W$) and consumption at the post-tax price of consumption ($P$). Thus, full income is defined as $FY = W.H + NLY = P.C + W.N$. The time endowment is $E = H + N$ where $H$ is the labour endowment. $E$ is set arbitrarily to 1 and the value of $N$ is set so that labour supply elasticities approximately match those in the literature.
Aggregate consumption in each region is a CDE (constant-difference-elasticity) combination of the six composite commodities. The allocation of aggregate consumption across commodities applies the CDE functional form (Hanoch, 1975) which specifies non-homothetic preferences. Composite consumption commodities are a CES combination of domestic and imported commodities. Real government consumption is assumed exogenous.

The current account to GDP ratios diverge from zero for all regions in the initial database. These ratios are slowly moved towards balance over the simulation horizon. This is achieved by allowing the saving rate to adjust. This condition determines the value of consumption in every period.

3.5 Foreign Assets and Liabilities

Wealth in each region consists of two assets: physical capital (direct investment) and financial capital (portfolio investment). Physical capital ($K$) is defined by industry, location, and owner. Foreign capital assets by regional owner is the sum of capital assets owned in all foreign locations. Foreign capital liabilities in a region is the sum of all capital owned by foreigners in the region. Each region also holds a debt instrument representing a composite of net financial assets held by each region.

For each region debt fluctuates to enforce the budget constraint on net foreign liabilities. Debt is allocated across regions by movements in the global interest rate, which is indexed to the net rate of return on capital. Note also that there is only a single interest rate as we assume perfect international arbitrage in financial assets. Thus, at the global level investors will equalise the rate of return on capital and portfolio investment ensuring the efficient allocation of global saving.

GDP from the supply side is defined as the sum of labour income, capital income and indirect tax receipts. GDP from the demand side equals the sum of consumption, investment,
government expenditure and net exports. Regional income is then defined as GDP plus capital income on FDI received by the region minus capital income paid on FDI in the region plus net interest receipts on debt held by the region.

3.6 Calibration and Baseline

The initial equilibrium is calibrated on version 9 of the GTAP database representing the world economy in 2011 (Aguiar et al., 2016). The data are aggregated to represent 17 individual APEC members and a composite region representing the rest of the world. The activities of foreign-owned firms are determined by applying data on foreign affiliate sales from Lakatos and Fukui (2012). We assume a common rate of return for all firms in each industry to reflect a long run equilibrium. Returns to foreign-owned firms represent part of net foreign income in each region. Net interest receipts on debt are calibrated by so that the capital account balance matches observed values based on IMF data (IMF 2019). Net debt for each region is then calculated for consistency with net interest income and the interest rate. The interest rate is set equal to the rate of return on capital.

The baseline path of the model begins from an initial equilibrium that evolves towards a balanced growth path. For high-income countries, the baseline is designed to move the economy from an initial steady-state to a new steady-state via a balanced growth path where all quantities eventually grow by between 2.8% and 3.3% per annum. Other countries are assumed to have not yet reached a steady-state, and so the baseline is designed to move the economy from an initial non-steady state towards a new steady-state via a balanced growth path where all quantities eventually grow by between 3% and 4%. Global consumer prices grow by 3.5% per annum (the recent average growth rate). Population and labour supply grow by 1% per annum and labour productivity by 2% per annum in all countries. Thus, divergences in the growth path across countries reflect initial differences in their investment-capital ratios.
4. Empirical Results

As the earlier theory demonstrated, liberalising foreign investment by reducing official barriers to it induces capital inflow to exploit new investment opportunities. Impediments to foreign investment therefore effectively act as a shadow tax on it. Abolishing cross-border investment barriers implies reducing this shadow tax, leading to a foreign investment influx as risk-adjusted rates of return on capital rise.

As we assume that the rental price of capital in each regional industry is the same for all suppliers of capital to that industry, additional foreign investment lowers the rate of return for all suppliers of capital in each industry, including domestic suppliers. In this way, increased foreign investment automatically brings with it benefits to the domestic industry in terms of a lower cost of capital. Furthermore, we follow the FDI literature and assume that foreign investment has embedded within it more productive technology, either in the form of lower costs or higher product quality (Markusen 2002).

4.1 Lowering the Shadow Tax

The change in the shadow tax is calibrated to reflect a one percentage point reduction in the initial rate of return in each industry in APEC countries. Investment liberalisation draws investment from non-APEC countries to APEC countries (Figure 3). The investment responses in APEC countries average around 4% in year 1, the year liberalisation occurs. The largest increases are for Japan (5.9%), the Philippines (5.7%) and the US (5.6%), and smaller increases for Australia (4.4%), Malaysia (4.9%) and Thailand (4.6%). These initial capital inflows by multinational firms are assumed to lead to increased total factor productivity in these firms. The increased productivity is calibrated to represent half of the initial capital inflow and it
applies in equal shares in the two years following the investment liberalisation. The remaining investment represents new capital using existing technology or maintenance thereof.

Capital inflows lead to proportionate growth in capital stocks (Figure 4). Initially capital stock growth is in foreign-owned firms. Over time, differences in rates of return are eliminated between domestic and foreign-owned capital, and both domestic and foreign-owned capital grow. Nevertheless, foreign-owned capital grows much more as these firms are more productive due to the investment inflow and thus increase their market shares.

4.2 Portfolio Foreign Investment

This CGE framework also captures international capital flows to APEC economies in the form of portfolio investment. Lowering barriers to portfolio investment and the shadow tax by one percentage point raises the ratio of net debt to GDP in most APEC countries, funded by lending from the rest of the world (Figure 5). Unlike physical capital, financial capital responds immediately to liberalisation and increased demand for physical capital in these economies. Increased cross-border financial flows imply net lenders, such as China and Japan, reduce their net lending positions, whereas net borrowers, such as Taiwan and the Philippines, increase their net borrowing positions.

Net capital inflow initially drives up the real exchange rate in most APEC countries reflecting increased investment expansion and hence net exports contract (Figure 7). But as the capital stock expands and supply increases to meet the increase in demand, domestic prices fall relative to world prices in APEC economies and net exports begin to recover until they are above baseline relative to GDP. This effect is particularly noticeable in Indonesia where the ratio of the trade to GDP is eventually 0.5 a percentage point higher.

In the long run portfolio investment liberalisation raises the capital-labour ratio in all APEC countries (see Table 1). The largest increases in the capital-labour ratio are in Australia
(1.15%), China (1.35%), Singapore (0.96%), and Canada (1.08%). GDP expands in all APEC countries with the largest increases in Indonesia (1.56%), China (0.82%), the Philippines (0.91%) and Australia (0.77%).

The welfare effects in present value terms are also presented in Table 1 which shows all APEC countries experience macroeconomic welfare gains, averaging around 0.3%. The largest macroeconomic gains are for China (0.41%) and Indonesia (0.44%).
Table 1. Long run macroeconomic effects (percentage change)

<table>
<thead>
<tr>
<th>Country</th>
<th>Labour</th>
<th>Capital</th>
<th>GDP</th>
<th>PV EV</th>
<th>PV EV ($US m)</th>
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<tbody>
<tr>
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<td>-0.10</td>
<td>1.05</td>
<td>0.77</td>
<td>0.38</td>
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<tr>
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<td>0.48</td>
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<tr>
<td>China</td>
<td>-0.75</td>
<td>0.61</td>
<td>0.82</td>
<td>0.41</td>
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</tr>
<tr>
<td>Japan</td>
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<td>0.24</td>
<td>0.45</td>
<td>0.33</td>
<td>194,433</td>
</tr>
<tr>
<td>South Korea</td>
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<td>0.54</td>
<td>0.62</td>
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</tr>
<tr>
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<td>0.59</td>
<td>0.61</td>
<td>0.32</td>
<td>39,730</td>
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</table>
5. Summary and Policy Implications

The Asia-Pacific region has driven world economic growth since the 2008-09 Global Financial Crisis. Expansion of international trade in goods and services is widely credited for boosting Asia-Pacific growth. UNCTAD data shows the scale of international trade flows in Asia far exceeds cross-border investment flows in the form of foreign direct investment (FDI). This difference suggests regulatory and ‘behind-the-border’ barriers are severely limiting FDI. To the extent these barriers are discouraging cross-border investment flows, growth in APEC is therefore potentially sub-optimal.

As argued in Makin and Chai (2018), at the microeconomic level foreign investment directly and indirectly generates economic gains through the transfer of technology and product development. Furthermore, the presence of new entrants in domestic goods and services markets introduces better management practices, stimulates imitative behaviour and spurs greater competition. At the macroeconomic level, increased foreign investment contributes to higher living standards by enabling saving and capital to flow to areas where it is used most productively.

This paper has shown that barriers to cross-border investment effectively impose a tax on economic development by distorting rates of return on capital. In theory, allowing capital to move to where it is most productively employed confers intertemporal macroeconomic gains that parallel those stemming from expanding international trade in goods and services.

The 1994 APEC Bogor declaration, which advocated “free and open trade and investment in the region”, has been the touchstone for APEC’s goal of greater regional economic integration in the Asia-Pacific. Yet, promotion of increased cross-border investment, especially foreign direct investment within APEC, has been weak compared to the emphasis on expanding regional international trade in goods and services. In contrast, this paper has yielded robust
theoretical and empirical results in support of facilitating greater FDI flows in APEC, suggesting APEC afford greater priority to deregulating barriers to cross-border investment.

Regulatory barriers explain why FDI flows in APEC are much smaller than international trade flows. These barriers include outright prohibition in certain industries, such as telecommunications, broadcasting, and banking, compulsory joint ventures with domestic partners, screening and approval processes, admission taxes, and restrictions on imports of labour, capital, raw materials and on repatriation of capital and profits.4

Apart from direct regulatory restrictions limiting foreign investment in APEC, a range of ‘behind-the-border’ barriers, such as high corporate taxes, lack of protection for intellectual property, and inflexible labour markets, worsen many member economies’ investment climate. By discouraging direct foreign investment, regulatory and ‘behind the border’ barriers stymie economic growth.

Further liberalising direct cross-border investment flows within APEC therefore suggests an alternative means of healing deep economic scars inflicted by the COVID-19 pandemic in the short term and for achieving higher living standards in the Asia-Pacific in the long term. Such liberalisation should be pursued by APEC members as a priority.

4 Contractor et al (2020) argue multinationals have increasingly viewed regulatory and institutional factors as impediments to cross-border investment in recent years.
Appendix 1  Micro-foundations of the Global Computable General Equilibrium Model

Production Technology

Production is distinguished by location (indexed by \( r \)) and owner (indexed by \( o \)). At the top level of the production nest, activity of the \( j (=1,\ldots,6) \) firms located in the \( r (=1,\ldots,9) \) regions and owned by the \( o (=1,\ldots,9) \) regions \( Q_{jro}^F \) is determined as a CES combination of the primary factor composite (i.e., an aggregate of land, labour and capital) \( Q_{jro}^F \) and the \( k (=1,\ldots,6) \) composite intermediate inputs \( Q_{kjro}^I \) using CES production technology:

\[
Q_{jro}^F = \left( \left( \sum_k \chi_k Q_{kjro}^I \right)^{-\rho} \right)^{1/(1-\rho)} \left( \frac{Q_{jro}^F}{A_{jro}} \right)^{\alpha}, \quad 0 < \chi_j < 1, \sum_j \chi_j = 1, \rho, \alpha \geq -1, \rho, \alpha 
\]

where \( \chi_k, \rho \) and \( \alpha \) are parameters and the \( A \) variables represent unit input requirements. The CES elasticity of substitution between intermediate inputs is \( \sigma = 1/(1+\rho) = 0.1 \). The CES elasticity of substitution between intermediate inputs and the primary factor composite is \( \sigma = 1/(1+\alpha) = 0.1 \).

At the second level of the production nest, firms combine the \( i (=3) \) factors of production, \( Q_{jro}^F \) using CES production technology:

\[
\frac{Q_{jro}^F}{A_{jro}} = \left( \left( \sum_i \kappa_i Q_{ijro}^F \right)^{-\varphi} \right)^{1/\varphi}, \quad 0 < \kappa_i < 1, \sum_i \kappa_i = 1, \varphi \geq -1, \varphi 
\]

where \( \kappa_i \) and \( \varphi \) are parameters. The CES elasticity of substitution between primary factors is \( \sigma = 1/(1+\varphi) = 0.5 \) based on the survey by Chirinko (2008).

At level 3, firms determine composite intermediate inputs by combining domestic \( Q_{ijro}^D \) and imported \( Q_{ijro}^M \) intermediate inputs using CES production technology:

\[
Q_{ijro}^I = \left[ \theta Q_{ijro}^D - \lambda + (1-\theta) Q_{ijro}^M - \lambda \right]^{-1/\lambda}, \quad 0 < \theta < 1, \lambda \geq -1, \lambda 
\]
where $\theta$ and $\lambda$ are parameters. The CES elasticity of substitution between imported and domestic intermediate inputs is $\sigma = 1/(1 + \lambda)$ and these range over 2.3–3.3 for traded goods (i.e., agriculture, mining, and manufacturing), and equal 1.9 for nontraded goods (i.e., services) based on Aguiar et al. (2016).

All firms are assumed to operate in perfectly competitive markets and so a zero-pure-profits condition is imposed that equates revenues with costs

$$P_{jro} Q_{jro} = P_{jro}^F Q_{jro}^F + \sum_k P_{kro}^I Q_{kro}^I + \sum_k P_{kro}^M Q_{kro}^M,$$

that determines $Q_{jro}$.

**Market Clearing**

The supply price for $(j,r,o)$-th industry $P_{jro}$ is linked to the market price $P_{jro}^{MKT}$ via $P_{jro}^{MKT} = P_{jro} (1 + T_{jro})$ where $T_{jro}$ is the output tax. $P_{jro}^{MKT}$ is determined via a market-clearing condition

$$Q_{jro} = Q_{D_{jro}} + \sum_s Q_{X_{jro}},$$

where the aggregate of domestic sales $(Q_{D_{jro}})$ (i.e., sales to firms, capital creators, households and government) and export sales to the $s$ (=9) destinations $(\sum_s Q_{X_{jro}})$ equals total output $(Q_{jro})$.

Total domestic sales by domestic firms and multinationals $(Q_{D_{jro}})$ is a CES composite of $Q_{D_{jro}}$

$$Q_{jro} = \left[ \sum_o \mu_o Q_{jro}^{-\pi} \right]^{-1/\pi}, \quad 0 < \mu_i < 1, \sum_i \mu_i = 1, \pi \geq -1, \pi \neq 0,$$

where $\mu$ and $\pi$ are parameters. The CES elasticity of substitution between outputs by all firms is $\sigma = 1/(1 + \pi)$ and these range over 4.9–7 for traded goods and equal 3.8 for nontraded goods based on Aguiar et al. (2016).
Total imports of the $j$-th good by the $s$-th region ($Q_{M_{j}}$) is a CES composite of $QX_{j}$:

$$Q_{M_{j}} = \left[ \sum_{o} \nu_{os} QX_{j,os}^{-\zeta} \right]^{-1/\zeta}, \quad 0 < \nu_{os} < 1, \sum_{o} \nu_{os} = 1, \zeta \geq -1, \zeta \neq 0,$$

where the CES elasticity of substitution between import sources is $\sigma = 1/(1 + \zeta)$ and these range over 4.9–7 for traded goods and equal 3.8 for nontraded goods based on Aguiar et al. (2016). Note that $Q_{M_{j}}$ defines import purchases of the $j$-th good in region $r$ by all agents (i.e., firms, capital creators, households and government).

**Investment and Capital Accumulation**

Investment by the $(j,r)$-th industry is determined as a positive function of the post-income-tax, net-of-depreciation rate of return on industry capital, $ROR_{j}$:

$$ROR_{j} = \frac{P_{j}^{CAP} K_{j} - \delta_{j} P_{j}^{INV} K_{j}}{P_{j}^{INV} K_{j}}.$$

Thus, $ROR_{j}$ equals as post-income-tax rentals on capital, $P_{j}^{CAP} K_{j}$, less capital depreciation, $\delta_{j} P_{j}^{INV} K_{j}$, divided by the replacement cost of capital, $P_{j}^{INV} K_{j}$. The definition of $ROR_{j}$ is equivalent to Tobin’s Q adjusted for taxes and depreciation.

Investment $Q_{INV_{j}}^{t}$ in year $t$ a positive function of $ROR_{j}$ in year $t$:

$$1 + \frac{Q_{INV_{j}}^{t} - \delta_{j} K_{j, t}}{K_{j, t}} = \left[ 1 + ROR_{j} \right]^{\gamma} F_{j}^{INV},$$

where $\gamma$ is the elasticity of the capital growth rate with respect to the rate of return, and $F_{j}^{INV}$ is a positive constant. Equation (10) is written using transformed formed versions (i.e., by adding one) of the proportionate growth in industry $j$’s capital stock $\left( 1 + \frac{Q_{INV_{j}}^{t} - \delta_{j} K_{j, t}}{K_{j, t}} \right)$ and the rate of return $\left( 1 + ROR_{j} \right)$. With $\gamma = 0.75$, a higher rate of return will lead to higher investment and higher proportionate growth in an industry’s capital stock.
\( Q_{jr}^{INV} \) is a CES composite of the \( k (=6) \) inputs to investment \( Q_{jr} \);  
\[
Q_{jr}^{INV} = \left[ \sum_k \psi_k Q_{jr}^{INV, k} \right]^{-\frac{1}{\xi}}, \quad 0 < \psi_k < 1, \sum_k \psi_k = 1, \xi \geq -1, \xi \neq 0,
\]
where the CES elasticity of substitution between inputs is \( \sigma = 1/(1 + \xi) = 0.1 \). \( Q_{jr}^{INV} \) is a CES composite of imported \( Q_{jr}^{INV, M} \) and domestic \( Q_{jr}^{INV, D} \) inputs to investment.

Capital creators are assumed to operate in perfectly competitive markets and so a zero-pure-profits condition is imposed that equates revenues with costs
\[
P_{jr}^{INV} \cdot Q_{jr}^{INV} = \sum_k P_{jr}^{INV} D_{jr}^{INV} + \sum_k P_{jr}^{INV} M_{jr}^{INV} + P_{jr}^{INV} M_{jr}^{INV}.
\]
The profits condition determines the supply price of investment by the \((j,r)\)-th industry \( P_{jr}^{INV} \).

All firms in an industry use capital specific to their industry. An industry’s capital stock available for use in year \( t \) \( K_{jr,t} \) equals its capital at the start of year \( t-1 \) \( K_{jr,t-1} \) less any capital depreciation during year \( t-1 \) \( (\delta_{jr} K_{jr,t-1}) \) plus any capital created (i.e., investment) during year \( t-1 \) \( Q_{jr}^{INV} \):
\[
K_{jr,t} = (1 - \delta_{jr}) K_{jr,t-1} + Q_{jr,t}^{INV}.
\]
Note \( \delta_{jr} \) is the constant rate of depreciation per period; thus, capital is assumed to depreciate geometrically over time. The representation of capital accumulation in equation (13) assumes that there is a one-year gestation lag between investment by firms and the increment to the capital available for use by firms. For each type of capital, there is an industry-specific rental rate that is determined by a market-clearing condition.

Given \( K_{jr} \), the movement of capital across the \( o \) capital owners in each industry is determined by a CET function:
\[
K_{jr} = B \left[ \sum_o \omega_o \left( Q_{jr,o}^{F} \right)^{-\rho} \right]^{-\frac{1}{\rho}}, \quad i = capital, B > 0, 0 < \omega_o < 1, \sum_o \omega_o = 1, \rho \leq -1,
\]
where $B$ is a technology parameter, $\omega_k$ is a share parameter, and the CET elasticity of transformation across owners is $\iota = 1/(1 + \rho) = -2.5$. The CET functional form is identical to the CES functional form except for the restrictions placed on $\rho$; with the CES form $\rho \geq -1$, with the CET form $\rho \leq -1$.

We define a market-clearing condition for capital that sets a common rental price of capital to all owners of capital in the $(j,r)$-th industry: $P^K_{jr}$. Thus, any change that causes a fall in the price of capital for any supplier of capital to the $(j,r)$-th industry will reduce the price of capital for all owners of capital in the $(j,r)$-th industry. Consistent with this treatment of rental prices by industry, in the initial data we set net rates of return to capital to be equal across all suppliers of capital to a regional industry. Thus, rates of return vary across industries within a region, but they do not vary across owners of capital within the same industry in a region.

**Household Consumption, Government Consumption and Saving**

The consumer’s utility function in each region is a CES combination of leisure ($N$) and consumption ($C$):

$$U = \left[ \beta^{\epsilon/\epsilon} N^{(\epsilon-1)/\epsilon} + (1 - \beta)^{1/\epsilon} C^{(\epsilon-1)/\epsilon} \right]^{\epsilon/(\epsilon-1)}, \quad 0 < \beta < 1, \epsilon \geq -1, \epsilon \neq 0,$$

where $\epsilon (= 1)$ is the elasticity of substitution between $N$ and $C$, and $\beta$ is a positive constant.

Upon deriving the leisure demand function we can define the uncompensated leisure demand elasticity as $\eta_N = -\eta_{ll} \left( \frac{1}{(E/H) - 1} \right)$ (Ballard, 2000) where $\eta_{ll}$ is the uncompensated labour supply elasticity. We set $\eta_{ll} = 0.2$ consistent with international evidence (Bargain et al., 2011). With $E/H = 1.55$ for most regions gives $\eta_L = -0.36$. Given the values of $N, \epsilon$ and $\eta_{ll}$ already chosen, $\beta$ will equal around 0.42. Combined these parameters give the value of the compensated leisure demand elasticity $\eta^*_N$ (Ballard, 2000). The compensated labour supply
elasticity is then \( \eta_{H}^* = (1 - (E/H)) \eta_{N}^* \) and equal around 0.32 for most regions. The income elasticity of labour supply is the difference between \( \eta_{H}^* \) and \( \eta_{N} \). These equal -0.12 for most regions, which is approximately equal to the values estimated in the literature (Ballard, 1990).

Aggregate consumption in each region \( C \) is a CDE (constant-difference-elasticity) combination of the \( m = 6 \) composite commodities \( C_m \). The allocation of \( C \) across \( C_m \) applies the CDE functional form (Hanoch, 1975) which specifies nonhomothetic preferences. The CDE implicit expenditure function is

\[
\sum_m B_m U P^{\beta_m} \left[ \frac{P_m}{E(P,UP)} \right]^{\gamma_m} = 1, \tag{18}
\]

where \( E(\cdot) \) is the minimum expenditure required to attain a prespecified level of household utility \( UP \) given the average price of household consumption \( P \). The vector of individual consumption prices \( P_m \) is normalised using \( E(\cdot) \). \( \beta_m \) are substitution parameters and \( \gamma_m \) are expansion parameters, and \( B_m \) are distribution parameters and represent budget shares. The normalised prices are raised to \( \beta_m \) and summed.

Following Hertel and Tsigas (1997), the uncompensated price elasticities are

\[
EP_{up} = \left[ APE_{up} - EY_m \right] B_p \quad \text{where } EY_m \text{ are the uncompensated income elasticities and}
\]

\[
APE_{up} = \alpha_m + \alpha_p - \sum_k B_k \alpha_k, \quad \forall m \neq p, \tag{19}
\]

\[
APE_{mm} = 2\alpha_m - \sum_k B_k \alpha_k - \frac{\alpha_m}{B_m}. \tag{20}
\]

Equation (17) and (18) define the own- and cross-price Allen partial elasticities of substitution, where \( \alpha_m = 1 - \beta_m \). Note that the cross-price elasticities \( APE_{up} \) are symmetric and that \( APE \) is a function of \( \alpha \) and the budget shares. Hertel and Tsigas (1997) note if \( \beta_m = \beta \ \forall i \), then the cross-price elasticities equal \( 1 - \beta = \alpha \) and the CDE function is equivalent to a CES
function. Also, if $\beta = 1$ then there is no substitution in consumption and if $\beta = 0$ the CDE function is equivalent to a Cobb-Douglas function. The uncompensated income elasticities are

$$EY_m = \left[ \sum_k B_k \gamma_k \right]^{-1} \gamma_m [1-\alpha_m] + \sum_k B_k \gamma_k \alpha_k + \left[ \alpha_m - \sum_k B_k \alpha_k \right].$$  (21)

The price and income elasticities will vary with the budget shares. $\beta_m$ is calibrated such that the chosen compensated own-price elasticities of demand are reproduced; then, $\gamma_m$ is calibrated such that the chosen income elasticities of demand are reproduced. The chosen elasticities vary by commodity and region and are taken from Aguiar et al. (2016).

**Foreign Assets and Liabilities**

Wealth in each region consists of two assets: physical capital (direct investment) and financial capital (portfolio investment). Physical capital ($K$) is defined by industry $j$, location $r$, and owner $o$: $K_{jro}$. Foreign capital assets by regional owner $o$ is $KA_o = \sum_j \sum_o K_{jro}$ for $r \neq o$. Foreign capital liabilities in region $r$ is $KL_r = \sum_j \sum_o K_{jro}$ for $r \neq o$. Each region also holds a debt instrument $D_o$ representing a composite of net financial assets representing as net stocks for each region, therefore $D_o$ can be either negative or positive.

For each region debt fluctuates to enforce the budget constraint on net foreign liabilities ($NFL$)

$$\Delta NFL_{r,j} = \Delta KL_{r,t} - \Delta KA_{r,j} - \Delta D_{r,j} + 0.5 \Delta CA_{r,j} = -CA_{r,j,t-1}, \quad \forall t.$$  (22)

Thus, minus the current account in $t-1$ $CA_{r,j,t-1}$ determines the accumulation of $NFL$ in $t$. Note that $NFL$ here represents the period average over $t$ and this requires that $CA_{r,j}$ also influences $\Delta NFL_{r,j}$. Debt is allocated across regions by movements in the global interest rate ($i$), which is indexed to the net rate of return on capital

$$i = ROR = \frac{\sum_j P^{CAP}_r K_{r,j} - \sum_j \delta_j P^{INV}_r K_{r,j}}{\sum_j P^{INV}_r K_{r,j}}.$$  (23)
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