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**EXAMINING THE DEFENCE
INDUSTRIALIZATION – ECONOMIC GROWTH
RELATIONSHIP: THE CASE OF SINGAPORE**

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ABSTRACT

This paper examines the process and political economy of defence industrialization in Singapore. It frames the emergence and evolution of Singapore's defence industrial base in the broader context of both the development of the Singapore Armed Forces (SAF) and Singapore's defence and strategic policy since independence. The first half of the paper traces the trajectory of defence industrialization, examining and problematizing the linkages between defence spending and economic development.

This paper suggests that while defence spending has acted as a stimulus for economic growth, especially in the Third World, Singapore's phenomenal post-1965 economic take-off seemed to occur independently of, even precede, any significant defence production, thus rendering highly problematic the direction and degree of causality between defence spending and growth. The second half of the paper offers a theoretical framework, which is used to examine the motivations behind Singapore's defence industrialization, focusing particularly on defence production self-sufficiency, or *autarky*. It goes on to argue that there has been an evolution from mercantilist perspective in the 1960s towards a more liberal approach in the 1990s. Finally, this paper examines how Singapore's pre-eminent defence firm, Singapore Technologies (ST), has responded to recent developments in the global defence industry, and how these strategic moves can be read as evidence of a shift from its initial mercantilist posture, and even as an abandonment of autarky.

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EXAMINING THE DEFENCE INDUSTRIALIZATION – ECONOMIC GROWTH RELATIONSHIP: THE CASE OF SINGAPORE*

Introduction

The relationship between defence and economic growth has typically been posed in terms of a ‘guns-versus-butter’ debate. Defence spending is often perceived as diverting valuable resources away from the civilian economic sector. Furthermore, high levels of defence spending impose financial burdens on a society that are unsustainable and may lead to economic instability or ruin. The flipside of the argument is that defence spending, inasmuch as it leads to secure states, creates an environment conducive to foreign investments and private economic activity, and thus provides the basis for economic development and growth.

The case of Singapore seems to support the latter argument. The growth of the Singapore Armed Forces (SAF) against the backdrop of Singapore’s well-documented post-independence economic success suggests a positive and symbiotic relationship between defence and economic growth. Broad economic growth fuels the development of the SAF, which in turn underpins the stability and security provided by sound defence capabilities.

The paper will examine this issue in two main sections. The first section focuses on the growth of the SAF during the 1980s and 1990s, a period of sustained economic growth interspersed with periods of economic recession, and examines Singapore’s defence-growth nexus. At first glance, the argument advanced in this section may suggest a positive relationship between defence and economic growth. On further reflection, however, this relationship may be more illusory, inasmuch as there were no serious military threats directed against Singapore.

The second section offers a theoretical framework for understanding the interplay between defence industrialisation and economic growth in Singapore. The

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framework draws on the two main theoretical traditions in the field of defence economics, namely mercantilism and liberalism. These theoretical traditions inform our understanding of the often problematic notions of defence and national security as ‘public goods’, the role of the state in correcting ‘market failures’ in the defence sector, and the spill-over effects of technology transfer between the defence and civilian sectors in stimulating growth. This section will also focus on the defence industrial base and delve deeper into the process of defence production by focusing on the question of whether defence industrialisation and spending growth induce or inhibit growth. In particular, empirical evidence from some of the major studies on Third World defence-growth trade-off from the late 1960s onwards is analysed and juxtaposed against Singapore’s own experience of in the similar timeframe. Finally, the section offers an analysis of Singapore’s indigenous defence industrial base, and speculates on the viability of autarkic practices in defence production amidst the globalization of the defence industry and supply chain.

Economic Growth and the Growth of the SAF

FDI and Human Capital

Several explanations have been forwarded to explain the relationship between defence and economic growth in Singapore.¹ One of the key elements has been the development of human capital that stemmed from the expansion of the SAF and the concomitant need for greater ‘professionalisation’. The shifting emphasis towards high technology weapons systems and capabilities to counterbalance the lack of geostrategic depth and its geopolitical weaknesses (e.g. small population size) generated a need for highly trained and educated professionals, particularly in the naval and air services (Chin 1987: 212-5).² Furthermore, during economic recessions, the SAF has proved useful in soaking up excess unemployed manpower (Chin 1987:

¹ It is noteworthy that the SAF itself posits a positive relationship between defence and economic growth. In Defending Singapore in the 21st Century (DS21), the following claim is made:

[We] hope to build for our children and ourselves a First World Economy and a World-Class Home. This vision can only be realised if Singapore is safe and secure, in a region that is peaceful and stable (2000: 5).

² A notable example of the role of human capital development has been the scholarship programmes within the military establishment. SAF and Ministry of Defence (MINDEF) scholars have been schooled in a variety of academic disciplines – management, computer science, engineering – and this has been at the leading edge of, if not partially responsible for, the development of the broader well-educated and highly-trained workforce in Singapore.

217), especially in the case of less qualified Singaporeans. Between 1984 and 1985 (the year of recession), SAF enlistments of other ranks up to Warrant Officer increased from 1,851 to 2,304. In the same period, contract service personnel in these ranks who decided to stay on increased from 539 to 711.

An alternative reading of the defence-growth nexus can be understood in terms of the dichotomy between the developmental and democratic models. The Singapore experience is a variant of the democratic model of the relationship between defence and economic growth (Alagappa 1988: 17-8). The emphasis is on a minimal military involvement, such as providing security as the basis for economic development. If the military is any more involved in economic growth, it is likely to be in security-oriented development projects (such as construction of infrastructure), civic action, or disaster relief operations.³ In this framework, a stable and secure polity (as a result of strong defence capabilities) is able to attract foreign direct investments (FDI) that provides for economic growth and development. In other words, there is a positive, linear progression between establishing a strong defence capability on the one hand, and experiencing economic growth and development on the other (Alagappa 1988: 33; Crouch 1988: 54-55).⁴ More recently, Alagappa has argued that the closing of the differential in military and civilian-economic skills has allowed the SAF to play a more direct developmental role (1988: 33).

It is also possible to argue that at least in a few industries, defence spending had a positive effect on it. Chin argues that this is especially the case with the aerospace industry, which has benefited from its linkages with the SAF (1987: 214-5). The point made is that although Singapore lacks the heavy industrial infrastructure to get into aircraft manufacturing, the aerospace industry has developed the potential to compete in smaller-scale aerospace enterprises, such as avionics, engine and airframe maintenance for small aircraft. This is also the case for other maintenance and

³ Interestingly enough, Alagappa argues that the democratic model is of less applicability to developing states (1988: 17; also see Crouch 1988: 49). In contrast, the developmental model posits a much more politically and economically interventionist military

⁴ For an impoverished state, which Singapore certainly was in the early years, this may represent one of the very few avenues through which economic growth can be generated, given the lack of indigenous capital for investment in economic enterprises. This positive relationship between defence and economic growth was demonstrated in negative fashion through the British decision to dismantle its military base in Singapore, and its subsequent impact on the economy: the loss of S\$900 million of British spending in Singapore over a four year period (Chin 1987: 206). This affected the economic livelihood of some 150,000 people whose lives had depended directly or indirectly on these British military bases, and which accounted for some 25% of the then gross national product (GNP) (Chin 1987: 195-6).

upgrading services – tapping into the Singapore experience in upgrading its various combat platforms at air, land and sea dimensions – which can be marketed at least to the immediate region (Alagappa 1988: 34).⁵

The Defence-Growth *Problématique*

The main arguments raised above illustrating the positive relationship between defence spending and economic growth can be problematic. The issue of the armed forces providing trained manpower for the economy for instance, Yong points out that the military can act as a competitor for this trained manpower with the civilian economy (1988: 287). Indeed, at the macroeconomic level, the ability of the defence sector to stimulate broader economic growth turns on the current level of resource utilization (Hartley and Sandler 1995: 201). Finally, as a later section will show, there is little evidence of military-to-civilian crossovers in Singapore resulting in commercial start-ups. Where trained manpower from the military sector has crossed over to the economy, anecdotal evidence suggests that this has been largely in managerial or technocratic areas, which has been useful to the Singapore economy up to the mid-1990s. But this has since proven to be less than completely useful in the ‘new economy’ paradigm of the 21st Century.⁶

Second, the evidence does not demonstrate conclusively if the intuitive argument mentioned earlier is correct, that it would be likely that defence spending drained off much needed resources for Singapore’s economic growth, or the counter-intuitive one where Singapore’s economic growth is critically dependent on defence spending which provided for a stable and secure polity and in turn encourages foreign investments and facilitates further economic development. As Table 1 demonstrates, however, neither argument seems to have been borne out by the evidence. Indeed, as Crouch argues, the military is not a major factor in economic development (1988).

⁵ Apparently, regional customers provided for 50% of Singapore’s defence industries during the early 1980s. Nevertheless, it might be prudent to not overstate the export potential of Singapore’s defence industries, given the market conditions of established defence contractors from the developed world, the overcrowding that has emerged in defence industries around the world as well as the post-Cold War excess capacity (see Ross 1989: 35-6; also Bitzinger 2003).

⁶ An interesting study of the Israeli experience of defence industrialization and its impact on the civilian economy attributes the bulk of technology transfer and other positive externalities from the defence to the civilian sector to individuals (Dvir and Tishler 2000: 38). The writers cite a 1998 report from Tel Aviv University’s Center for Technological Forecasts that estimated that 35% of the entrepreneurs were trained in R&D during their military services and 57% of these were officers in the Israel Defense Forces.

Table 1

Singapore Military Expenditure and Economic Growth

Year	Military Expenditure (\$millions)	GNP (\$millions)	GDP (\$millions)	GDP Growth Rate
1974	576.2	12192.6	8445.2	6.3
1979	998	20373.4	12114.1	9.4
1984	2262.4	39848.3	18261.5	8.2
1985	2410	39012.1	17928.6	-1.8

Source: Chin 1987: 208-9.

It could be argued that in 1974, the SAF was still in its infancy, its order of battle (ORBAT) was fairly limited in terms of conventional military capability. One decade later, the SAF was already in possession of a rapidly maturing conventional military capability. Indeed, as another study shows, Singapore's defence spending has over the years manifested a remarkable consistency both in terms of overall government spending and as a proportion of GDP (see Table 2).

Table 2

Singapore's Defence Budgets, 1966-1996

Year	Defence Spending (\$millions)	Defence Spending as % of Government Spending	Defence Spending as % of GDP
1966	36	6.8	1.1
1971	461	23.7	6.8
1976	670	23.2	4.6
1981	1498	21.9	5.1
1986	2152	18.8	5.5
1991	3440	21.5	4.6
1996	5878	21.4	4.5

Source: Huxley 2000: 28.

This suggests that the two (the development of military capabilities and economic growth) occurred concurrently, and that the direction of causality has proven extremely difficult to determine, much less the degree. Based on the empirical evidence, it seems difficult to escape the conclusion that economic growth occurred concurrently with defence growth, which problematises the causal relationship between defence and economic growth.

The Political Economy of Singapore's Defence Industrialisation

Theoretical Underpinnings of Defence Economics

The relationship between defence and economics has had a long and rich theoretical tradition. Furthermore, the articulation of the distinct field of 'defence economics', and the development of various research agendas and approaches, has been fraught with difficulties simply because of these highly contested traditions.⁷ In terms of methodology, this paper adopts an essentially neoclassical approach, but also suggests that in understanding the dynamics of defence industrialisation, as well as the role of the state in that process, it would be fruitful to temper the economic approach with a 'political economy' dimension. Indeed, as will be shown in subsequent sections, the emergence of Singapore's defence industrial base can best be explained by a combination of political and economic factors, rather than solely economic ones.

The first theoretical tradition discussed in this section is mercantilism, which is the economic doctrine that deals most directly and explicitly with the question of defence and national security. There are two main reasons for this. First, mercantilism as an economic doctrine can be seen as a corollary to realism in international relations theory in that they both proceed from the premise that 'states must seek both security [for the realists] and prosperity [for the mercantilists] in an anarchic international environment' (Kapstein 1992: 1, additional comments mine). Hence, the state played an important interventionist role, domestically and internationally, to secure and expand on its objectives of political, military and economic security. Mercantilism therefore consisted in 'the pursuit of wealth and

⁷ Hartley and Sandler define defence economics in a minimal fashion, stating that it 'applies the tools of economics to the study of defence, disarmament, conversion and peace' (1995: 1). A more comprehensive description of the field is provided by Intriligator:

Defence economics is concerned with that part of the overall economy involving defence-related issues, including the level of defence spending, both in total and as a fraction of the overall economy; the impacts of defence expenditure, both domestically for output and employment and internationally for impacts on other nations; the reasons for the existence and size of the defence sector; the relation of defence spending to technical change; and the implications of defence spending and the defence sector for international stability or instability (1990: 3).

The above definition is generally accepted as a fair and reasonable representation; however, Judith Reppy exemplifies the alternative 'political economy' approach that can be adopted in which there is greater emphasis on the unique institutional features of the defence system being analysed (1991).

power...that would be needed, among other things, to finance warfare (Kapstein 1992: 2). This resonates strongly with the realist view of international relations in which a powerful state is underpinned by, among other things, a strong economy. The mercantilist economic doctrine also led to the 'infant industries' argument often made in favour of protecting industries that are deemed important to the state, including the industries that constitute the defence industrial base. The argument is essentially that 'not only the wealth but the independence and security of a county appear materially connected with the prosperity of manufactures'.⁸

The second theoretical tradition, liberalism, is no less concerned with issues of defence and national security. According to Kapstein:

The liberal would agree that the provision of national security is the foremost goal of the state, and that in order to fulfil this goal the state may have to intervene in certain instances in order to mobilize capital, labour, and natural resources (1992: 10).

Indeed, classical liberal economists such as Adam Smith and David Ricardo identified on one hand a fundamental tension between the *laissez faire* doctrine of market forces and the limited role of the state, and on the other hand the unique feature of defence as a public good. Because defence as a non-rival and non-excludable public good is prone to market failure, it was incumbent on the state to correct that market failure by being the monopoly supplier of defence and national security.⁹ Hence, as Kapstein puts it, 'national defence...fell outside Smith's *laissez faire* framework' (1992: 5).

The mercantilist and liberal approaches to the questions of defence and national security share common ground in that national defence and economic well-being are intertwined: economic gains and access to materiel fuel a country's ability to defend itself, while a country secure from conflict and strife provide a stable

⁸ This a quote from the 'Report on Manufactures' presented to the U.S. Congress in 1791 by the Treasury Secretary Alexander Hamilton, cited in Kapstein (1992: 2). Although dated, it remains one of the most succinct expressions of, and justifications for, mercantilist economic policies. The argument today could be modified to refer to defence industries, rather than manufactures in general.

⁹ Defence economics, and the broader area of public sector economics, defines public goods in terms of two main characteristics: non-excludability and non-rivalry of the good's benefits. As defined by Sandler and Hartley, 'benefits of a good are non-excludable if they are available to all once the good is provided'. A good is non-rival when 'the good is consumed by one individual (agent) without detracting, in the slightest, from the consumption opportunities still available for others from that *same* unit (1995: 4)'. Because of these two characteristics, market failure occurs in the sense that no private actor could be relied upon to provide an inherently public good simply because they could not charge others for it, and there was no incentive for them to supply it.

platform on which prosperity can be created. The two schools of thought diverge on the question of the trade-off between defence and growth, and the methods in which countries undertake defence production. The mercantilists believe that in matters of defence, countries should be autarkic or self-sufficient. Furthermore, this stance is maintained even in the face of comparative disadvantage in defence sectors.

Compared to the liberals, mercantilism pay little attention to the explicit and opportunity costs that are incurred when productive resources are allocated away from the civilian sectors towards defence production. However, the liberal tradition is concerned about the economic cost extracted by military spending. Furthermore, given the dictates of comparative advantage, defined broadly to mean that countries should produce *and* trade the goods in which they have an inherent advantage in specialising, maintaining a domestic defence industrial base would be for many countries a highly inefficient exercise and tolerated only because of the peculiar ‘public good’ nature of defence. In an overly simplistic fashion, therefore, it would seem that the liberals are apologists for the role of the state in providing national security, whereas the mercantilists unabashedly celebrate state interventionism in the defence sector.

Given the theoretical framework articulated above, how might one explain the Singapore government’s approach to questions of defence economics? Roughly speaking, one could argue that Singapore has evolved from a broadly mercantilist perspective in the 1960s, and has since the late 1980s and early 1990s graduated towards a liberal approach, especially in the areas of procurement, exports of its own defence products and the civilianisation of the defence firm. This change has also coincided with the globalization of the defence industry and the revolution in military affairs (RMA). The evolution of Singapore’s defence industrial base is examined in the following section.

Singapore’s Defence Industrial Base and the Defence-Growth Trade-off

In examining the development of Singapore’s defence industrial base and the implications for the broader economy, it is necessary to study the the ‘defence

industrial base' in greater detail. Dunne adopts a fairly basic definition of the defence industrial base as one that is '[constituted by] those companies which provide defence and defence related equipment to the defence ministry' (1995: 402). He justifies this definition by pointing to its 'rather ephemeral character' (*ibid*: 401).¹⁰ A report by the Center for Strategic and International Studies defines the defence industrial base in functional terms:

[The] defence industrial base is defined as the aggregate ability to provide the manufacturing, production, technology, research, development, and resources necessary to produce the materiel for the common defence (1989: 11).

For the purposes of this paper and its analysis of the Singapore case, it suffices to define the defence industrial base as those sectors of the economy that produce goods, services and technology for the defence establishment.

The defence industrial base lies at the heart of the defence-growth nexus simply because its emergence is due to decisions (economic and non-economic ones) made on the allocation of a country's resources between 'guns' and 'butter'. As mentioned before, the uniqueness of the defence sector and the imperatives of national security are such that many countries maintain a defence industrial base even though it may not be efficient for them to do so. The mercantilist and liberal paradigms offer contrasting justifications for this. For the mercantilists, the maintenance of the defence sector results from the desire to 'pick winners' and nurture 'infant industries' even in the face of comparative disadvantage. The liberals, however, recognise the intrinsic market failure in the provision of the defence public good, and hence a role for the state to play in correcting that market failure. Given the necessity of the state's role, the object of the exercise is to maximise efficiency given such exogenously determined constraints (Hartley and Sandler 1995; Kapstein 1992; Chan 1991: *passim*).

¹⁰ Minimalist definitions of the defence industrial base, like the one used by Dunne, allow for the identification of the larger and more obvious defence companies, such as producers of weapons systems and munitions. However, difficulties arise when considering the so-called companies straddling both the civilian and defence sectors. Such companies include producers of non-lethal but strategic products such as vehicles and fuel, as well as other products consumed by the defence establishment such as food and clothing. If such an expanded definition is used, then one concludes that all countries, to varying degrees, have a defence industrial base.

There are also extra-economic reasons for building and maintaining a defence industrial base. As Nicole Ball puts it in her analysis of defence industrialisation in the developing world,

Third World countries seek to produce their own weapons for a combination of political, military and economic reasons. A domestic weapons production capacity can be seen as an expression of national sovereignty, tangible evidence that a country intends to defend its independence (1991: 175).

In a nutshell, a national defence industrial base is regarded as a vital aspect of national pride and sovereignty. There are other reasons that are often cited for defence industrialisation. One major reason is that a national defence industrial base affords security of supply and eliminates the risk of potentially unreliable foreign suppliers of vital defence equipment, especially in times of crisis or conflict. Hence, the strong desire to avoid dependence on foreigners for critical defence hardware (Hartley and Sandler 1995: 185-88). The second reason with implications for broader economic growth is the potential impact of defence industrialisation on overall economic growth, particularly for the developing world. Developing an indigenous defence industry that can satisfy most of the defence establishment's needs might be a way to save scarce foreign exchange; it might facilitate the mastering of new technologies; and it might kick-start a broader socio-economic process of industrialisation (Bitencourt 1995: 171).

The point of departure for this debate is typically Benoit's studies on the effect of defence spending on economic growth in developing countries from 1950-1965, roughly the period corresponding to the wave of decolonisation in the Third World (1973, 1978).¹¹ Benoit's studies found that developing countries with heavy defence spending generally had the highest growth rates, while those that spent least on defence had the lowest growth rates. Several explanations have been offered to account for how defence spending could stimulate growth in the developing world. The first is the fiscal stimulus effect that occurs in countries experiencing periods of unemployment (or under-employment), which could be caused by under-consumption

¹¹ Benoit's findings spawned a series of subsequent studies which had varying results. However, as the literature developed, a consensus emerged that an important distinction had to be drawn between the case of defence spending in the developing country, as with Benoit's two studies, and the case of defence spending in the developed world. This paper confines itself to assessing the impact of defence spending on developing countries.

or under-investment. Put simply, a heavier defence burden would result in an increase in the level of resource utilization, thereby generating growth. Furthermore, as is often the case in developing countries, civilian uses of resources might not be optimal to begin with, and hence the defence-growth trade-off does not apply (Hartley and Sandler 1995: 200-220 *passim*; see also Chan 1991: 207-9). The stimulus effect that defence spending has on the economy would also tend to be short-lived, and would cease as soon as the economy is at or near full employment.

The second positive externality is the longer-term structural effect of technological and infrastructure modernization that is brought about by defence industrialisation. According to Hartley and Sandler, 'nations can experience direct technological effects and spin-offs from the defence sector' (1995: 201). Advances made in the defence sector are transmitted to the civilian sector through a process of technology and knowledge transfer, thereby improving a country's long term growth prospects. In addition, Ball cites the instances where defence industrialisation and modernization resulted in job creation and manpower training or human capital formation (1991: 182). Again, these benefits apply more to the case of less developed countries, where the initial starting conditions for technology and manpower infrastructure is a low base, and where such benefits would experience a diminishing rate of return as the country becomes more developed.

Despite the number of studies, neither economic theory nor analyses of the data provide any conclusive support for the growth promoting or growth inhibiting effects of defence spending. Chan sums up the unsatisfactory state of the field in the following manner:

[...] even though we understand the processes through which military spending can affect economic performance much better now than [before], there remains much that we do not know or that we disagree about (1987: 35).

While broad generalisations on the defence-growth dynamic remain problematic, the studies by Benoit *et al.* have proven to be extremely useful insofar as they offer alternatives to the conventional thinking about defence. These studies point out that military spending 'crowd out' private investment and current consumption, and divert resources from other public goods such as health and education. Defence spending

also siphons R&D resources away from the civilian sector, which is viewed to be more efficient and of greater socio-economic utility. Finally, military spending usually results in budget deficits, which reduce the national savings rate, and hence impinges on the long-term rate of investment. For example, if military spending is financed through increased taxation, this could in turn reduce consumption (which would impact short-term growth) and/or investment (which would affect the longer-term structural growth dynamics).¹² Finally, there is little concrete evidence of positive spin-offs from defence industries to the civilian economy (Bitencourt 1995: 171-2).

In the case of Singapore's experience of defence industrialisation, one can make a case for mercantilistic origins that have evolved into a more liberal approach. The case for mercantilism and the primacy of political preferences over economic criteria can be seen in the way in which the defence-growth trade-off is transcended and rendered moot because national security takes precedence over economic issues. Hence, while the allocation and production decisions (i.e. second-order 'micro' decisions) are driven by the confluence of economic and political considerations, ultimately it is the 'politics' that drives the 'economics' when it comes to the first-order 'macro' decisions of whether to embark on a course of defence industrialisation (Kuah 2004: *passim*).

In his study of Singapore's defence industries, Bilveer Singh first makes the point that 'defence industries are...the political industries of a country', with twin goals of attempting self-sufficiency and reducing dependency on foreign suppliers (1990: 38). Furthermore, Singh's contextualisation of the birth of Singapore's defence industries within the trauma of separation of Singapore from Malaysia in 1965, and the 'survival crisis' faced by the People's Action Party (PAP) government, lends support to the defence industrial base's mercantilistic origins. As Singh argues,

[O]ne of the many responses of the PAP in overcoming the "survival crisis" was to establish a viable defence capability, and with that was implanted the seeds of the local defence industry (*ibid*).

¹² Examples of studies that argue there is a trade-off between defence and growth, even in the developing world, include Faini, Annez and Taylor (1984) and Lim (1983).

Moreover, Singh also argues that the ‘political’ assumed primacy over the ‘economic’ in the decision to proceed with defence industrialisation:

Dr Goh [the Defence Minister], against the advice of Sir Laurence Hartnett, the consultant employed to advise the government on SDI [Singapore’s Defence Industries] matters, determinedly pushed for the local defence industry in order to supply the internal needs of the SAF; the rationale being, ‘it was strategically and militarily a necessity’.

Clearly, the decisions on defence production and procurement do not necessarily have to make economic sense when political and strategic imperatives are deemed to be a higher priority. The desire for self-sufficiency, or autarky, is based on several factors. First, an independent self-sufficient defence industrial base was seen as key to ‘preserving a credible military deterrent, as well as reducing its exposure to outside suppliers and the possible cut-off of vital arms during a crisis or conflict... (Bitzinger 2003: 12)’. Second, reduced reliance on foreign suppliers was viewed a means of strengthening national political independence (*ibid*: 13); in other words, a strong defence industrial base was seen to be an important element of sovereignty.

Singapore is by no means unique in its desire for arms autarky. Sweden’s Second World War experience of having arms supplies cut off led to the rapid development of its defence industrial base; also, the sudden withdrawal of Soviet military aid in the 1960s and the Western arms embargo post-Tiananmen also fuelled China’s desire for arms autarky. However, the challenge for these second-tier countries is not simply whether autarky is viable given the current state of the defence market and technology but whether the defence firms that make up a significant part of the overall defence industrial base can actually survive in their present forms amidst escalating costs, reduced demand and ever-increasing technology barriers.

By the 1990s, a fundamental shift had occurred within Singapore’s defence industrial base. First, there was a civilianisation of the defence industry’s flagship company, Singapore Technologies (ST), which saw it dramatically reducing its overall dependence on Ministry of Defence contracts. Although the military business remained central to ST, accounting for 70 percent of its revenue, there was nevertheless a concerted effort to expand civil operations (Huxley 2000: 191). In addition, ST started to play a vital role in facilitating technology transfer to the civilian sector. This was possible both because of existing civilian contracts as well

as the emergence of dual-use innovations and technologies (*ibid*). Also, prior to the civilianisation process, economic and business considerations had started to enter the calculus of the defence industry's operations, and this is seen most clearly in the export of domestically designed and produced weapons and equipment. The pre-eminent examples of such successful exports include the SAR (Section Assault Rifle) 80 and the Ultimax-100 light machine gun.

The global strategic landscape had also changed dramatically in the 1990s with the end of the Cold War and the stirrings of strategic transformation, or the RMA. In the United States, the consolidation and rationalisation of the industry has resulted in a small group of mega-firms dominating the US defence industrial base. Given the higher information-technology demands associated with the RMA and the emergence of dual-use technologies, governments have become increasingly reliant on global suppliers to fulfil the needs of their military establishments. For example, the software in many weapon systems could originate from any part of what is now a global supply chain (The Economist, 10 June 2001: *passim*).

In Europe, the defence industrial landscape has undergone a similar series of mergers and acquisitions, but also has an additional transnational dimension to the rationalisation process: hitherto national defence industries have given way to transnational defence markets and corporate structures and an increasing pan-European propensity to collaborate on specific projects. The transnationalisation of defence production has been epitomized by the emergence of EADS and BAE Systems. Although the defence sector is different from the civilian sector, and there will be limits to globalization and the cross-border collaboration of technology, these trends have nevertheless changed the preferences of defence firms and governments alike. For the leading defence firms, consolidation is motivated by the belief that 'big is beautiful' and the rush to benefit from the cost-savings of off-the-shelf procurement approach of governments. The corollary to this is that governments are becoming more and more predisposed towards foreign contractors in fulfilling their procurement needs, sometimes in preference to national defence firms, that are often inefficient.

These changes in the structure of the global defence industry has also affected Singapore's defence industrial base, although the dynamics and responses that these changes have provoked have played out differently compared to the US and Europe.

Using Bitzinger's framework of first-, second- and third-tier arms producing countries, it is possible to differentiate amongst the various responses to the globalization and rationalization of the global defence market (Bitzinger 2003).¹³ First-tier countries have consolidated and transnationalised their defence firms, resulting in the cross-border super-mergers mentioned above. In a nutshell, first-tier defence firms have adopted the 'big is beautiful' approach, and are secure in the knowledge that their long-term viability is not in doubt despite the reduced global demand for weapons systems and other defence goods (Bitzinger 2003: 6).

However, long-term viability of second-tier countries (including Singapore) is very much in doubt, especially given the globalization of the defence industry and the rapidly encroaching technology and costs barrier. Bitzinger argues that by the early 1990s, the second-tier states had not only failed to attain autarky, but also that their defence industrial bases had become unviable:

[Second-tier defence industrial bases] have not been able to achieve autarky – that is, self-sufficiency in weapons design and technology – or efficiency – that is, making arms manufacturing cost-effective or deriving much in the way of economic benefits. Most important, arms production among second-tier states has become increasingly unsustainable (2003: 25).

If one accepts that the developments in the global defence industry pose severe constraints on the viability of second-tier defence firms, then Singapore Technologies' recent strategic moves can be read as 'defensive' (no pun intended) responses to ensure its survival:

- **Diversification/Civilianization.** Singapore's Business Times reported on 30 April 2004 that ST Engineering (the listed entity of Singapore Technologies) was expanding its commercial activities to complement its core defence

¹³ This paper adopts Bitzinger's 'tier' classifications while recognising the definitional problems that are inherent in such setting out such categories. Bitzinger's first-tier countries are the US, the UK, France, Germany and Italy, which collectively account for 75% of global arms production, and moreover dominate the R&D process. The third tier countries are defined as those possessing limited low-technology production capabilities. Bitzinger himself concedes that second tier countries would simply be those along the spectrum between the most and the least advanced countries. Unfortunately, Bitzinger admits that second tier is something of a 'catholic group' being comprised of industrialized countries such as Australia, Canada, Norway, Japan and Sweden, as well as industrializing countries such as Argentina, Brazil, Israel, Singapore, South Africa and South Korea (2003: 6-7).

competency.¹⁴ In ST Engineering's 2003 Annual Report, the company announced that its ST Aero division had entered into a joint venture with China Eastern Airlines to set up commercial aircraft maintenance, repair and overhaul facility in Shanghai (2003: *ix*).¹⁵

- **Leveraging dual-use technologies for civilian/defence production.** A recent example that was highly visible in Singapore was ST Elect's adaptation of military surveillance technology in thermal imaging into temperature screening at airports and other public places at the height of the SARS epidemic in 2003 (*ibid*). Also, given that four of ST Engineering's divisions – ST Aerospace, ST Electronics, ST Kinetics, ST Marine – derive their revenues from a diverse range of civilian and defence clients further suggests that there has been some success in leveraging dual-use technologies (Singapore Technologies Engineering Limited Annual Report, *various years*). However, while the larger first-tier firms are likely to effectively exploit dual-use technologies, particularly those emerging from the primarily IT-based RMA, it remains to be seen if second-tier firms are able to leverage dual-use technologies to the same degree, if at all (Bitzinger 2003; Matthews and Treddenick 2001).
- **Arms exports.** This is the most obvious and straightforward means by which second-tier firms have attempted to respond to inadequate domestic demand. However, given the global trend towards reduced defence budgets (the US notwithstanding) and consequently decreased demand, second-tier firms exports of 'mid-tech' defence goods may not prove viable in the long term, especially in the face of the unfolding IT-based RMA. Still, Singapore Technologies' land systems division, ST Kinetics, has managed to strengthen its position in the traditional defence core business by shifting its emphasis to 'smarter, network-centric solutions' such as multi-role land systems and guided weapons and munitions (Singapore Technologies Engineering Limited Annual Report 2003: 95). At the same time, ST Kinetics retains its core competency in delivering on battlefield engineering systems on the domestic

¹⁴ 'Broadening its horizons', by Kenneth Lim, [Business Times](#), 30 April 2004 (on-line edition).

¹⁵ This was just a recent example of commercialisation/civilianisation moves made by Singapore Technologies. As indicated earlier, this strategic shift can be traced back to the early 1990s (see Huxley 2000: 184-95)

front, with the *Primus* howitzer (detailed below), and external front, with its Bronco All Terrain Tracked undergoing rigorous trials by potential customers in Europe and Turkey (*ibid*: 96).

- **Globalization and international collaboration.** The globalization/internationalization is a key strategy for Singapore Technologies:

[ST Engineering] is a company that wants to grow. Globalization will enable us to do that. It opens new opportunities and untapped markets beyond our shores. It gives us access to new capabilities to enhance our existing expertise. We have made the internationalisation of our business a core objective in recent years...[and believe] that an increased global presence and network is absolutely critical to sustain long term growth... (Singapore Technologies Engineering Limited Annual Report 2003: 19).

However, ST Engineering's globalization strategy is predicated on a mix of acquisitions, alliances and joint ventures with companies in the US and China, just to name a few. However, there is a critical difference between tying up with first-tier defence firms and non-first-tier firms: the variant of defence globalization in which second-tier firms are junior partners to first-tier companies results in. As Bitzinger puts it:

[S]econd tier firms] formally subordinat[e] themselves to first-tier companies...[with] plans for self-sufficient arms production...[and] supplanted by a return to greater degrees of dependence upon foreign armaments and technologies...(2003: 75).

Clearly, Singapore Technologies has employed a multi-pronged approach to respond to the challenges and constraints of defence globalization and escalating economic and technology costs. In terms of the civilianisation, dual-use technologies and exports strategies, the central question is to what extent these measures continue to be viable in a shrinking defence market place. The more critical issue, however, is globalization strategy. It can be argued that Singapore Technologies' partnerships with first-tier defence firms (especially in the US) pose serious obstacles to defence autarky. Furthermore, combined with the ever-increasing rate of technology adoption within the SAF, the globalization strategy is paradoxically making Singapore more and more beholden to foreign suppliers. Ironically, defence globalization, while

diffusing technology from the first-tier countries to the periphery, has at the same time allowed the leading-edge defence companies to concentrate and consolidate its hold over the second-tier countries through its monopoly on advanced technologies and R&D.

Given the above, the unveiling of the Singapore Self-Propelled Howitzer 1 - called the *Primus* - by the Singapore Armed Forces (SAF) in November 2003 was particularly noteworthy, even anomalous.¹⁶ The development and launch of the *Primus* was noteworthy for being an in-house enterprise by the Defence Science and Technology Agency, ST Kinetics and the SAF, and essentially going against the current trend of second-tier countries outsourcing, buying 'off-the-shelf' and customising to local requirements. The *Primus* emphasised the limits to which the outsourcing of defence production could occur and that the decision to develop and produce locally was rarely based purely on economic criteria. (Kuah 2004: *passim*).

Singapore's defence industrial base has taken measures to ameliorate against the rising costs of domestic design and production and the small domestic market, as can be seen in some of ST Engineering's latest moves both locally and abroad. Furthermore, with global tensions (to the extent that such tensions affect conventional arms spending) receding, the economic rationale for the defence industrial base has begun to supersede the political one. In the case of Singapore's defence industrial base, the transition from mercantilistic origins in the 1960s (with the announced intention of autarky) to liberal approaches in the 1990s (with the tacit acceptance that true autarky was not viable) has been borne out in some of the strategies adopted by Singapore Technologies.

¹⁶ 'S'porean high-tech artillery gun is unveiled', by David Boey, [The Straits Times](#), 25 November 2003 (on-line edition). In the article, a MINDEF spokesman emphasised the importance of developing hardware to suited its 'unique needs'. Clearly, designing a new piece of equipment was preferable to simply satisfising with a 'second-best' option of customising the best available hardware.

Conclusion

In terms of the impact of defence spending on economic growth, Singapore in many respects does not conform to studies on Third World defence industrialisation conducted by Benoit *et al.* While there has obviously been an impact, the question is whether defence industrialisation was a significant driver of Singapore's economic development. Singapore's defence industrial base has clearly delivered what the theory has postulated, in terms of job creation, human capital development and technology development and diffusion. According to Singh, '[Singapore's Defence Industries] has provided direct employment to more than 11,000 people' (1990: 57). Furthermore, Singapore's defence industries '[forms] the backbone of Singapore-based and owned technology-oriented industries' (*ibid*).

The Singapore experience of defence industrialisation is significant in that it occurred alongside a highly successful economic development strategy, one based on interventionist industrial policy and export-oriented industrialisation. The infusion of foreign capital, talent and technology and the steady advance up the value-chain from low-technology textiles in the late 1960s to the high-technology manufacture of semiconductors and memory chips in the late 1980s through to the present re-engineering of the economy towards greater knowledge-intensive technology such as IT and biotechnology, have clearly been the determining factor in Singapore's economic success story.¹⁷ In this regard, Singapore does not conform to the 'prototypical' Third World case of defence spending generating positive externalities. This is because Singapore's defence industrialisation occurred amidst steadily increasing economic output and a steady growth dynamic that was quite independent of any impact from defence spending.

Furthermore, the ability of Singapore's pre-eminent defence firm to respond effectively to the pressures of defence globalization and rising financial and technology costs, when compared to the experiences of other second-tier defence

¹⁷ Singapore's economic success is well-documented, either on its own, or as part of the so-called 'Four Asian Tigers', i.e. South Korea, Taiwan, Hong Kong and Singapore. For a succinct overview of Singapore's developmental experience, refer to Haggard, Stephan. (1990). Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries. New York: Cornell University Press.

firms, appears to be *sui generis*.¹⁸ Hence, any benefits that might have accrued to Singapore either through the spending stimulus effect or structural transformations were not reaped as Singapore's broader economy was already starting to trend towards full employment. Besides, if one puts stock in Singh's argument that 'the trend in the SAF weapon acquisition is one driven by technology (Singh 2003: 37)', then the defence-growth trade-off in Singapore is fundamentally modified in that it is technological developments, albeit mostly external ones, that drives defence spending, rather than the imperatives of defence needs that fuel domestic defence research and development. In the Singapore experience, it is more the case of defence spending providing a stable and secure platform for broader socio-economic development, rather than defence being a direct and significant growth driver of the economy.

The diverse issues at the centre of the defence-growth debate, and the difficulties encountered by the various studies in attempting to generalize the relationship, has led to the somewhat unsatisfactory conclusion that 'the phenomena in question are sufficiently complex as to defy simple universal statements ostensibly applicable to all countries at all times' (Chan 1991: 203). Indeed, Georgiou and Smith made an apt observation regarding the current state of the field:

[If] there can be any single observation about the effects of military expenditure on the economy, it must be that it depends on the nature of the expenditure, the prevailing circumstances, and the concurrent government policies (1983: 15).

The experience of Singapore suggests that these caveats, however unsatisfactory in terms of theory they may be, are essentially correct. The Singapore experience is one that suggests that defence spending and industrialisation has not had much impact on the economic growth of the state. The growth in defence spending has occurred because of economic growth, and the early growth of the Singapore economy had little to do with the ability of the SAF to provide for a stable and secure country. Singapore's experience remains a likely cautionary note for policy-makers, that when policy-makers seek to create economic growth for their respective states, they ultimately must create their own path, find their own tailor-made solutions to their unique set of problems and conditions. Of course, the guns-versus-butter debate is not always as stark a choice as is portrayed (see, for instance, Brandt 1986). The

¹⁸ See Bitzinger (2003). Also, Markusen and Costigan (1999) for an excellent exposition of the global defence market.

experience of Singapore suggests that states can have both – guns and butter – without entailing overly deleterious effects on either side of this equation. Chin Kin Wah notes, ‘With such financial endowments, Singapore ... was spared the stark choice between defence and economic development’ (1987: 211). At the risk of oversimplification, Singapore could afford all its guns simply because butter was abundant.

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