University of Nottingham
Taiwan Research Hub

A policy paper

Semiconductors: Taiwan's case of 'Dutch disease'?

by
Michael Reilly

University of Nottingham
Taiwan Research Hub

Michael Reilly
Taiwan Research Hub, University of Nottingham

Semiconductors: Taiwan's case of 'Dutch disease'?

No product is more central to international trade than semiconductors

Chris Miller, *Chip War*

Summary

The impact of the Covid-19 pandemic on global supply chains highlighted the importance to the world of semiconductors, and dependence on Taiwan for their manufacture. In their contemporary strategic economic importance they have been likened to oil in the 1970s and 1980s. In the late 1970s, *The Economist* newspaper coined the term 'Dutch disease' to describe how the growth of natural gas exports from the Netherlands in the 1960s led to the Dutch currency appreciating, making its manufactured exports more expensive and thereby prompting a decline in manufacturing.

This paper argues that the dominance of the semiconductor industry is having a similar impact on the Taiwanese economy. The difference is that themain symptom of the 'disease' is not an over-valued exchange rate, thanks to central bank policymakers who have been effective at managing it, but the 'crowding out' of other sectors that the dominance of the ICT industry has created. The very success of the semiconductor industry has helped to hide these weaknesses and engendered a sense of complacency on the part of policy makers. The Taiwanese government needs to take urgent action for the country's long -term survival.

- It needs to encourage diversification within the economy. Full implementation of measures to ensure the economy meets CPTPP accession standards should help achieve this.
- The central bank should reduce its intervention to manage the NT$ exchange rate, allowing the rate to respond more to market forces.
- The government should reduce the number and influence of state-owned enterprises in the economy, through privatisation or corporatisation. This would encourage competition and allow room for other businesses to grow.

Introduction

Semiconductors have been good for the Taiwanese economy. Today, Taiwan produces 41% of all processor chips used around the world and more than 90% of the most advanced chips, which in turn account for almost 40% of the country's merchandise exports and 15% of its gdp.[i] Driven in large part by chip exports, from 1995 to 2021 Taiwan's annual average economic growth rate of 4.24% was more than double the average 2.05% of OECD economies. By 2022 its nominal per capita GDP had surpassed those of both South Korea and Japan. In purchasing power parity (PPP) terms, Taiwan now ranks 13th globally for GDP per capita, ahead of all G7 countries bar the USA.[ii]

The growing political importance of semiconductors has benefited Taiwan too. The deterioration in US-China relations and growing fears of a conflict have highlighted the current dependence on Taiwan for them. Senior western politicians have visited Taiwan in numbers unmatched since the late 1990s, when their respective bilateral trade with Taiwan often matched or exceeded that with China.[iii]

But could this apparent success be creating problems for the wider Taiwanese economy, or masking shortcomings within it? In the 1970s *The Economist* newspaper coined the term 'Dutch disease' to describe the impact on the Dutch economy of the discovery of natural gas. The subsequent surge in exports of this generated a big increase in foreign demand for guilders to pay for the gas, raising the exchange rate. This made Dutch imports relatively cheaper and exports more expensive and therefore less competitive. While the sectors of the economy linked to natural gas did well, others went through painful restructuring or simply disappeared.[iv] More recent examples include the impact of North Sea oil on the Norwegian and British economies, or of strong demand from China for its iron ore and coal on that of Australia.

The 'Dutch disease' is typically attributed to discovery of or high demand for a natural resource. The economists Max Corden and Peter Neary have argued, however, that it could be caused by anything that leads to a relatively sudden and sharp inflow of foreign currency, including exports from a booming manufacturing sector.[v] The consequences of the overvalued exchange rate usually include an economic boom as consumers enjoy cheaper imports. Typically, the boom leads to increased spending on services, raising their prices but leading also to a move of labour to the service sector as demand there increases, thereby increasing labour costs generally. Traditional export sectors therefore feel a double squeeze, from the overvalued exchange rate and rising labour costs, leading to painful readjustment within the economy.

This paper argues that the Taiwanese economy is showing symptoms of the 'Dutch disease' which are attributable to the rise of the semiconductor industry but that two important factors have so far limited the impact.

- Government policies intended to help Taiwanese companies remain competitive have enabled them to avoid taking measures to adjust to the rise of the semiconductor industry. But this has been at a price, as structural weaknesses and rigidities in the economy remain unaddressed. These include the influence of state-owned enterprises, the very small size of many private companies, and the difficulties of raising capital, especially for new entrants. The longer this continues, the more painful and prolonged will be the inevitable adjustment.
- Robust growth has not yet translated into higher wages. As average wages have remained below the level that might have been expected, so the consumer boom and service sector growth typically associated with the 'Dutch disease' have not materialised. The is likely due to the dampening effect on Taiwanese wage demands created by the risk of production being offshored to China. This in turn means that the benefits of increased semiconductor production have flowed disproportionately to capital rather than labour.

A potentially important further factor, which really merits separate investigation, is the cyclical nature of the semiconductor industry which has been characterised by regular cycles of 'boom and bust' with periods of tight supply and high prices followed by over-supply and falling prices. To the extent that these cycles are more intense, or of shorter duration, than similar cycles in natural resource prices, so the wider effects are likely to be more limited.

Taiwanese exports and the rise of semiconductors

Following the disruption caused by the Covid-19 pandemic, Taiwanese exports reached a record US$477.8 bn. in 2022. As Chart 1 shows, if we compare total merchandise export growth with

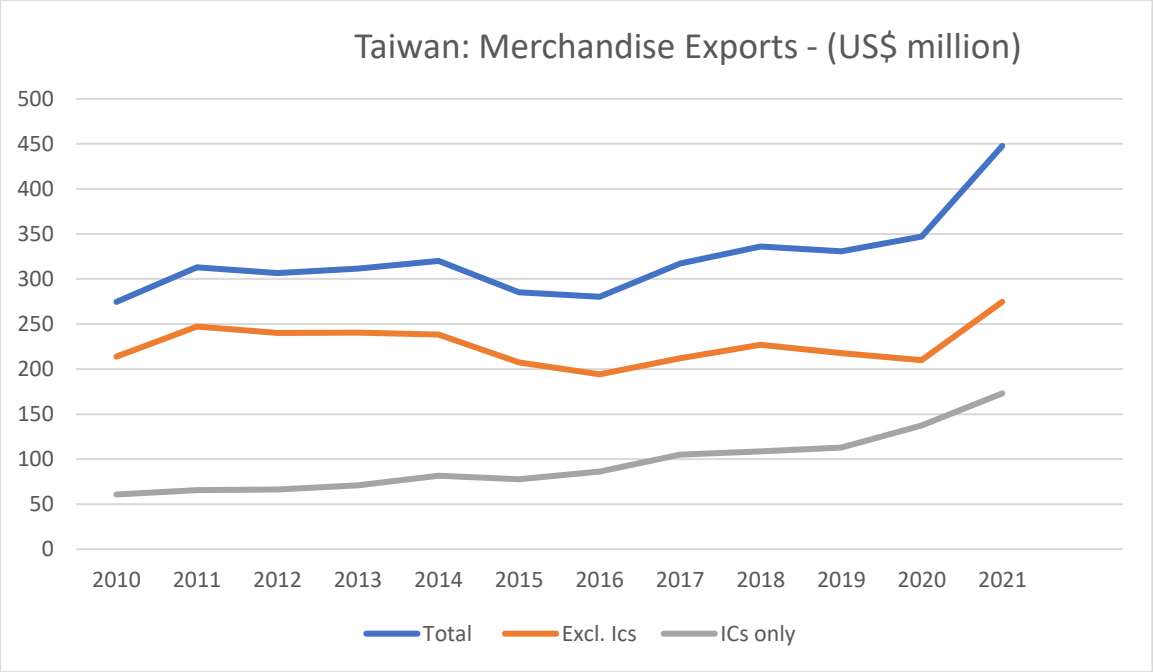

Chart 1: Taiwanese Merchandise Exports, 2010 – 2021

Source: World Trade Organisation statistics database, https://stats.wto.org (ICs = integrated circuits)

the growth of semiconductor or integrated circuit exports, it is quickly apparent that since 2010 most of the overall export growth has come from semiconductors. As a proportion of total exports, these almost doubled from 22% in 2010 to 39.5% in 2020, the increase gathering pace from 2015. If semiconductor exports are excluded from the picture, between 2010 and 2020 Taiwanese merchandise exports fell 1.8%.

An even more striking picture emerges if we look at Taiwan's exports to its largest market, China. In the 2008 presidential election, Ma Ying-jeou was elected on a platform of boosting economic growth through improving relations with China. In 2010, the bilateral Economic and Co-operation Framework Agreement (ECFA) was signed and as Table 1 shows, from 2008-2015, during Ma's term of office, Chinese imports from Taiwan grew 40%. While this may seem impressive, it was slower than the growth of China's imports from the rest of the world, such that from 2008 to 2015, Taiwan's share of China's imports fell from just over 9% to less than 7%.[vi]

	2008	2011	2013	2015	2018	2020	2022
Imports from Taiwan, Total	103,338	124,911	156,405	143,204	177,614	200,498	236,937
Imports of Electrical Equipment from world (1)	266,515	350,954	439,417	428,694	521,632	548,420	642,371
Imports of Electrical Equipment from Taiwan	41,525	57,053	89,593	87,272	113,660	139,438	182,125
Imports of Electrical Equipment from Korea	22,956	33,860	47,633	81,475	100,046	84,660	110,532
Imports of integrated circuits from Taiwan (2)	29,530	41,061	72,162	68,585	97,561	124,037	158,553

Table 1: Chinese Imports of Electrical Equipment 2008 - 2022
Source: UNCTAD*: International Trade Statistics,* PRC General Administration of Customs statistics*;* Units: US$ million
(1) HS product code 85, Electrical and electronic equipment.
(2) HS product code 8542, Electronic integrated circuits, and micro-assemblies

By 2022, matters had recovered and 8.8% of all China's imports came from Taiwan, which had again become its leading source of imports, despite growing political tensions. As Table 1 shows, however, this was almost entirely due to imports of semiconductors. Between 2008 and 2015, despite the overall decline in its market share, Taiwan increased its share of Chinese electronics imports by over one-third. If we break this down further and look at semiconductors, the trend is even stronger. By 2022, electronics comprised 77% of all Taiwan's exports to China and 87% of these were semiconductors, accounting for 25% of all China's imports of electronics. The trend is clear, and worrying. Semiconductor success for Taiwan is not matched by success in other export sectors, and is even having a negative influence on them.

This would matter less if there was no alternative to Taiwan as a source of semiconductors. In the short term this may be the case, but there are now sustained efforts by other countries, including the USA, China and in Europe, to build up their own capabilities. It is therefore in Taiwan's long term interests to encourage the growth of other sectors to avoid over-reliance on semiconductors. Reducing the obstacles that Taiwanese exporters face to entering some other markets, including tariffs, quotas, and regulatory requirements, would be a helpful step towards this. Although Taiwan is a member of the World Trade Organisation (WTO), Chinese opposition has prevented it from joining regional trade groupings which are increasingly setting the agenda in trade liberalisation. The government has, however, applied to join the Comprehensive and Progressive Trans-Pacific Partnership

(CPTPP) trade bloc. As the bloc is committed to reducing regulatory impediments to trade, membership should help Taiwan's traditional export sectors.

- **The government should continue with its bid to join the CPTPP. While accession is unlikely to happen for some years, ensuring domestic industry meets all the requisite CPTPP requirements is an essential first step, which the government should pursue urgently.**

The exchange rate

Other things being equal, the high global demand for semiconductors should drive up demand for Taiwan dollars to buy them, unless there has been a matching growth in Taiwanese imports or an increase in Taiwan's foreign currency holdings. We should therefore expect to see the Taiwan dollar appreciating steadily against the US dollar in line with the increase in semiconductor exports, especially from 2015.

Contrary to what we might expect, in nominal terms the rate has remained relatively stable since 2000. It has fluctuated around a median exchange rate of 30.5 New Taiwan dollars (NT$) to the US dollar, with a low of NT$35 to the US dollar in January 2002 in the aftermath of the collapse of the 'dot.com boom.' The highest rate was 27.5 in April 2021, at the peak of the global chip shortage.[vii]

Taiwan trades with the world, however, not just the USA, so looking only at the Taiwan dollar – US dollar exchange rate may not give us the most accurate picture of whether the currency is under- or overvalued. If we consider the rate of the Taiwan dollar against a basket of currencies (a weighted composition of the currencies of its main trading partners), rather than just the US dollar, and adjust this to allow for the impact of inflation on exchange rates, we can see from Chart 2 that a slightly different picture emerges.

This shows a gradual long-term appreciation of the currency, albeit with short term variations, presumably reflecting Taiwan's balance of payments position in any one year. Significantly, the trend of an appreciating Taiwan dollar became more marked after 2016, in line with the increase in semiconductor exports demonstrated in Chart 1 but even while other exports were stagnating. (The apparent decline in the exchange rate in 2022, a period when exports were booming, can perhaps be explained by the strength of the US dollar at the time, which was at high or even record levels against many currencies).

Taiwan's foreign currency reserves, historically some of the largest of any country, have also grown steadily over the last decade, from US$400bn. in 2011 to an all-time high of US$558.4bn. in February 2023. This suggests that Taiwanese policy makers are periodically intervening to limit the rise of the Taiwan dollar.[viii]

The presumed aim is twofold: to build up an adequate cushion of foreign exchange reserves and to maintain the competitiveness of traditional export sectors by preventing the exchange rate from rising too far or too quickly.[ix] Some former officials at Taiwan's central bank have argued however that attempts to keep the exchange rate low have simply encouraged Taiwanese exporters to concentrate on producing cheap goods rather than on innovating.[x] By helping to protect otherwise uncompetitive industries it also acts as a barrier to economic diversification and thereby could lead to significant adverse consequences over time.

Chart 2 – Real effective exchange rate for Taiwan dollar
Bank for International Settlements, Real Broad Effective Exchange Rate for Chinese Taipei [RBTWBIS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/RBTWBIS, April 10, 2023.

Intervention also brings a political risk. In 1998 and 1992 the US Treasury designated Taiwan a 'currency manipulator' and it came close to doing so a third time in April 2021, despite the relative strength of the Taiwan dollar at the time. This annual exercise by the Treasury is meant to monitor whether countries manipulate the exchange rate to prevent effective balance of payments adjustments and thereby gain an unfair advantage in international trade. Only China and Taiwan have been designated a 'manipulator' more than once. Although reduced intervention would most likely mean a short term appreciation in the exchange rate, bringing with it some painful restructuring, the cost and difficulty of such restructuring will only rise the longer it is delayed.

- **The central bank should reduce its intervention to manage the NT$ exchange rate, allowing the rate to respond more to market forces.**

Employment and wages

The third most likely area for symptoms of the 'Dutch disease' to appear is the impact on domestic employment and wage rates. Normally a booming industry will require more labour to meet increased demand and other sectors of the economy will be forced to increase wages too, or risk losing employees to higher paying sectors. (There are some exceptions, for example if the boom sector is very capital intensive and therefore requires a relatively low amount of extra labour to meet demand).

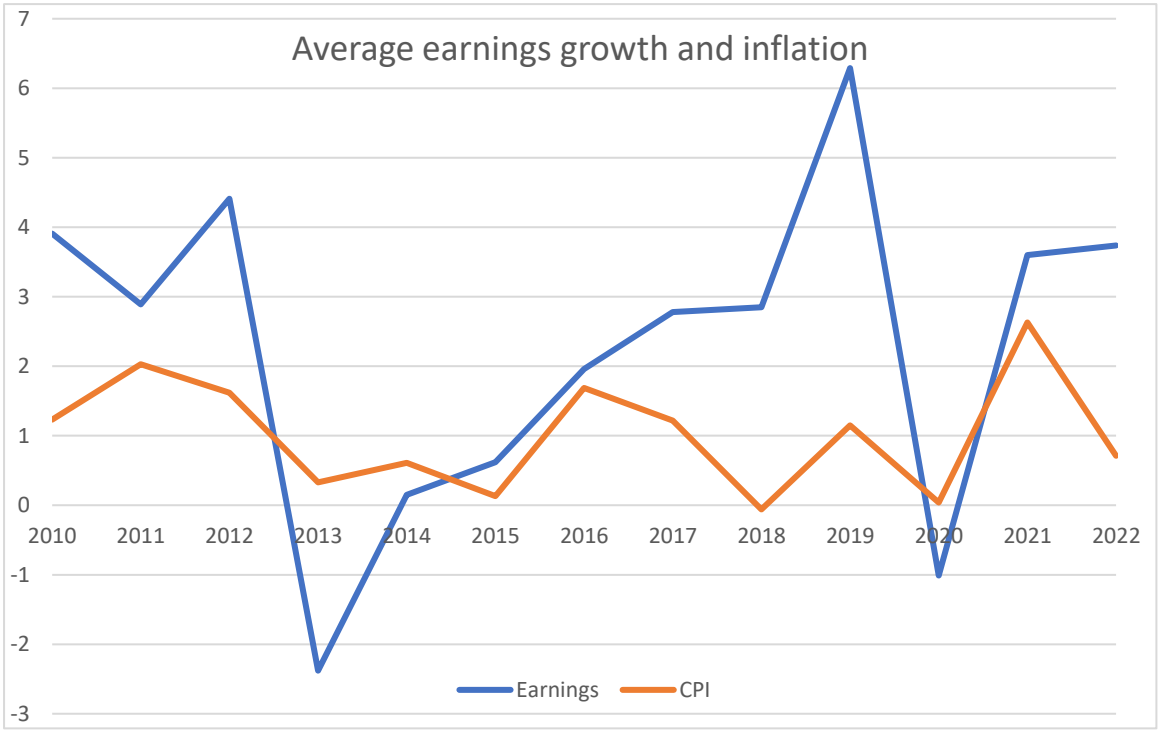

Chart 3: average annual growth in earnings and annual consumer price inflation, both in percentage terms, 2010-2022

Source: Monthly regular earnings of all employees, industry, and services and year-on-year CPI change rate, DGBAS, Taiwan

Chart 3 shows the annual growth in average monthly earnings for all employees in Taiwan from December 2010 to December 2022, compared with annual consumer price inflation over the same period. One would normally expect to see a degree of correlation between the two, with earnings usually responding to higher inflation, albeit with a time lag. The limited correlation in Taiwan's case is therefore striking, suggesting that inflation has only a modest impact, if any, on Taiwanese wage growth.

On the other hand, if we compare this with Chart 1, there is a much closer correlation between wage growth and export growth. A seeming exception occurs in 2019-20, when wage growth was negative after a record increase the year before, while exports continued to grow. But overall export growth was influenced by a large rise in semiconductor exports that year, and a reasonable assumption would be that semiconductor manufacturers increased wages to ensure they had enough staff to meet orders that were being placed or were anticipated. Traditional exports declined in value terms for two consecutive years.

This suggests that earnings in the semiconductor industry may not be closely linked to those in other sectors. Evidence suggests that the semiconductor industry offers average pay some 40% higher than average wages in the economy overall, while the recent global shortage of chips and strong demand saw wages in the sector rise steadily over the last three years.[xi] This may also help explain the high average earnings growth in 2019, if semiconductor manufacturers went on a hiring spree in response to strong demand or to forestall a potential loss of skilled labour to Chinese competitors.

The semiconductor industry is more capital intensive than other areas of the economy and therefore employs relatively few people, but those it does employ are more highly skilled. As chips have grown ever more powerful and smaller, the costs of their production have soared. A single Electronic Ultraviolet (EUV) photolithography machine made by Dutch supplier ASML, and essential for manufacture of the most advanced chips, costs around US$200million while a full-scale fabrication plant ('fab') today costs upwards of US$20billion to build and equip. The manufacturers therefore have every incentive to pay their employees enough to recruit and retain them and ensure there are sufficient to keep expensive capital equipment fully utilised.

But we might still expect to see higher wages in semiconductors having an impact on the rest of the economy, even if it is muted. For example, more highly paid staff might opt to spend more of their disposable income on consumer goods or services, the increased demand for which should feed through into higher wages in those sectors too. There is some anecdotal evidence to support this, but it is local to the Hsinchu area (the site of the main semiconductor facilities), for example in very high property prices in the area. Looking at the whole economy, however, there are signs that the reverse is the case – that low wages in other sectors hold back earnings growth in the semiconductor industry too.

A 2015 study by the OECD ranked Taiwan third worldwide for the average annual number of hours worked at 2134 hours per person, with real wage stagnation for most of the previous fifteen years. [xii] While conditions have improved somewhat since then, at the equivalent of US$1873 by the end of 2022 the average monthly wage in Taiwan was still only a little over half the South Korean average of US$3428.[xiii] (These figures help explain why Taiwan ranks so much higher than Korea in per capita GDP when measured by PPP). Relatively low wages may also be a reason why a service sector boom has not materialised so far in Taiwan.

A plausible explanation for this relative wage stagnation is the impact of China. After China and Taiwan joined the World Trade Organisation (WTO) in 2001 and 2002, Taiwanese manufacturers increasingly opted to invest in China, where the labour supply was almost unlimited and the cost of it lower, rather than at home. (Honhai-Foxconn alone employs in China the equivalent of more than 10% of the entire Taiwanese labour force.[xiv]) Instead of importing labour to the Taiwanese plants, as electronics manufacturers had done in the 1990s, they exported the plants to the source of labour.

As this investment has grown, so too have fears amongst the Taiwanese labour force of job losses from 'offshoring' and of workers therefore willing to forgo pay rises to keep their jobs. It may be significant that the high earnings growth recorded in 2019 occurred as wider political sentiment towards China was changing, encouraging moves away from investing there. If semiconductor manufacturers judged it prudent not to expand their operations in China but to do so in Taiwan instead, they may have had little choice but to pay more to attract enough employees.

Another explanation may lie in the structure of other sectors of the Taiwanese economy. Outside the semiconductor and electronics industries, much of the export sector remains dominated by relatively traditional manufacturers, most of them small and medium enterprises (SMEs). Around 75% of Taiwanese work in organisations employing fewer than 200 people, more than half of them in ones with fewer than 30 employees.[xv] The traditional Taiwanese business model revolves around low-cost, low-margin operations and, one suspects, relatively low skills. Such businesses will be dependent on low-cost labour to remain viable. They are also most susceptible to a loss of labour to an expanding service sector. Government intervention to prevent significant increases in the exchange rate is

therefore likely to benefit such businesses but at the cost of impeding the expansion of the service sector.

Meanwhile, state-owned or state-controlled enterprises and import substitution activities protected by non-tariff barriers and domestic regulations dominate the domestic economy. The state-owned sector is exemplified by the Taiwan Sugar Corporation, 86% government owned and operating hypermarkets, convenience stores and filling stations, as well as breeding pigs and ostriches and growing orchids. Other state-owned examples include the largest domestic bank, Bank of Taiwan, alcohol production (Taiwan Beer) and even a half-share in a film animation company (Wang Films). The import substitution sector is well demonstrated by automobile assembly. Although this has declined since 2014, the industry still assembled over 260,000 vehicles in 2022, barely more than the output of a single UK plant. Fewer than 20% of these were exported.[xvi]

The dominance of such companies

inhibits structural change within the economy, as potential new enterprises or sectors find it hard to raise capital or recruit labour in the face of established businesses which enjoy a degree of government protection. This risks increasing dependency on the semiconductor industry in the long term, making the inevitable restructuring more costly and painful when it happens.

- **Reducing the number and influence of state-owned enterprises in the economy, through privatisation or corporatisation would encourage competition and allow other businesses to grow, thereby encouraging diversification.**

Conclusion

Sustained government intervention has so far helped the Taiwanese economy avoid the worst effects of 'Dutch disease' from the rise of the semiconductor industry. But semiconductors are still accounting for an ever-increasing share of Taiwan's exports. This intervention has simply delayed the impact and with it the necessary structural adjustment.

The Taiwanese government needs to take more radical and faster action, especially as other governments press TSMC to invest in plants in their own countries. The longer action is delayed, the greater will be the eventual cost to Taiwan. Specifically:

- The government should ensure the economy meets CPTPP accession standards in full. This should help encourage diversification by easing barriers to entry for new enterprises.
- The central bank should reduce its intervention to manage the NT$ exchange rate, allowing the rate to respond more to market forces.
- The government should reduce the number and influence of state-owned enterprises in the economy, through privatisation or corporatisation. This would encourage competition and allow other businesses to grow.

[i] Miller, C: *Chip War, The fight for the World's most critical technology,* 2022; *The Battle over Semiconductors is endangering Taiwan*, https://foreignpolicy.com/2022/11/09/tsmc-taiwan-battle-semiconductors-water-resource-scarcity/, retrieved 17 November 2023

[ii] International Monetary Fund, *World Economic Outlook database*, October 2022, https://www.imf.org/external/datamapper/NGDPDPC@WEO/OEMDC/ADVEC/WEOWORLD?year=2022, retrieved 6 April 2023; *Country GDP figures*, World Bank, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2021&start=1995&view=chart; *National Statistics*, Republic of China (Taiwan), https://eng.stat.gov.tw/Point.aspx?sid=t.1&n=4200&sms=11713

[iii] For details of European visitors in the 1990s see Mengin, F. *A functional relationship: Political extensions to Europe-Taiwan economic ties,* China Quarterly 169, Cambridge 2002. In March 2023, German Education Minister Bettina Stark-Watzinger was the first German cabinet minister to visit Taipei in 26 years and in January 2023 the Czech and Taiwanese presidents spoke by telephone. In 2021, the Taiwanese foreign minister made an official visit to Prague.

[iv] For an excellent, non-technical explanation of the Dutch disease, see Ebrahimzadeh, C: *Dutch disease: Wealth managed unwisely*, https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Dutch-Disease, retrieved 31 March 2023;

[v] Corden, W.M and Neary, J.P: *Booming Sector and De-industrialisation in a Small Open Economy,* Economic Journal, December 1982, pp 825- 848

[vi] Reilly, M: *The Real Trade Challenge for Taiwan and Tsai Ing-wen*, The Diplomat.com, 30 June 2016, http://thediplomat.com/2016/06/the-real-trade-challenge-for-taiwan-and-tsai-ing-wen/

[vii] https://tradingeconomics.com/taiwan/currency, retrieved 31 March 2023

[viii] Taiwan foreign exchange reserves, https://www.ceicdata.com/en/indicator/taiwan/foreign-exchange-reserves, retrieved 10 April 2023

[ix] Chou, Y-H and Tsai, C-Y: *Sources of current account fluctuations in Taiwan: 1989 – 2015,* Empirical Economics 2021, pp 2125 – 2151; Taiwanese policy makers defend this on the grounds that as Taiwan is not a member of the International Monetary Fund (IMF) it does not have recourse to international support arrangements and therefore needs to maintain a higher level of reserves to cover economic shocks than might otherwise be considered necessary.

[x] *Taiwan dollar drops with US set to apply currency manipulator tag,* Financial Times, 13 April 2021, https://www.ft.com/content/c66fa027-ffe3-4846-919d-5a741894935a

[xi] Hsu, C: *Yearly average wage rises to highest in seven years,* Taipei Times, 23 November 2022

[xii] Reilly, M: *Towards an EU-Taiwan Free Trade Agreement – Prospects and Pitfalls,* 2018, p.36

[xiii] https://www.ceicdata.com/en/country/, retrieved 7 April 2023

[xiv] *Hon Hai now has more than one million employees in China,* China Post, 14 December 2010

[xv] DGBAS: *Persons engaged and payrolls of establishment units of all industries* from 2016 census.

[xvi] https://www.ceicdata.com/en/indicator/taiwan/motor-vehicle-production; https://www.driving.co.uk/news/business/nissan-issues-warning-over-future-of-sunderland-car-plant/

About the Author

Michael has been a non-resident Senior Fellow, first of the China Policy Institute, then the Taiwan Studies Programme, at Nottingham since 2015. Michael is a former British diplomat with extensive experience in East Asia including postings in Korea (twice) and the Philippines. His final position was as the British representative in Taiwan from 2005 – 2009. He then left the foreign service to join BAE Systems, serving as the company's chief representative in China from 2011-2014. He is a member of the Advisory Board of the Global Taiwan Institute in Washington DC and was a Visiting Fellow at Academia Sinica in Taipei in 2016 and 2019.