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THE CRISIS IN ASIA: AN EMPIRICAL ASSESSMENT

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ABSTRACT

The economies of South East Asia and Korea have been shaken by a financial and economic crisis that has enveloped the region since mid 1997. There are competing explanations for the cause of the crisis however most commentators would agree that a major shock that impacted on the countries has been a dramatic increase in the perceived risks of investing in these economies. This paper explores the impact of a re-evaluation of the risk in the Asian economies focussing on the differential real consequences of a temporary versus more permanent rise in risk. It contributes to our understanding of the possible consequences of the Asia crisis by applying a global simulation model that captures both the flow of goods as well as international capital flows between countries. The real impacts on the Asian economies of a rise in risk perceptions in the model are large and consistent with observed adjustment. However the spillovers to the rest of the world are relatively small because the loss in export demand that accompanies the crisis in Asia is offset by a fall in long term interest rates as capital flows out of Asia into the non-Asian OECD economies. Thus strong domestic demand in economies such as the US induced by the general equilibrium effects of the reallocation of financial capital can more than offset the consequences of lower export growth. The analysis also highlights the impacts on global trade balances reflecting the movements of global capital and points to both potential problems and lesson for policymakers over the coming years.

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1. Introduction

The economies of South East Asia and Korea have been shaken by a financial and economic crisis that has enveloped the region since June 1997. The repercussions of this largely unanticipated shock on the economies in Asia and on the world economy are yet to be fully revealed. Although it is clear whatever the ultimate consequences on actual economic activity this shock has "the capacity to change thought about economic development and economic policy in fundamental ways" (Garnaut(1998)). Rather than look at the lessons for economic thought, this paper focuses on the likely economic adjustments to the crisis and in particular the likely spillovers from Asia to the rest of the world taking into account both the capital flow and trade effects.

In particular this paper focuses on one important (and perhaps the most important) aspect of the crisis in Asia. That is, the impact on the Asian economies of a jump in the perceived risk of investing in these economies. In setting the stage for the analysis that follows, section 2 outlines the various arguments as to the likely cause of the crisis. This section points out that there were both systemic as well as country specific problems that can be identified in the lead up to the crisis during 1996 and 1997. There was a range of problems that were specific to individual countries and had been the focus attention over many years, such as significant government intervention in a range of economic decisions, corruption, poorly developed financial systems, lack of financial supervision etc. However, it is difficult to see how these problems which varied in scale and relative importance actually caused the crisis in those economies most severely affected. Each problem likely contributed in its own way to differing degrees of the severity of the crisis that followed the collapse of the exchange rate peg in each country. In addition to the country specific problems, there was a common macroeconomic problem across these economies. In each country the pegging of the exchange rate in various degrees to the US dollar caused increasing pressures

during 1996 and into 1997. One problem with the exchange rate peg was that these currencies appreciated relative to the Yen especially during 1996 and 1997. During 1996 the Yen depreciated by 11% against the US Dollar. This made products from the economies pegging to the US Dollar less competitive in the important Japanese market. In addition, during 1996 capital continued to flow into the region forcing countries with pegged exchange rates to cumulate foreign exchange reserves. In some countries this led to a loosening of monetary policy which was reflected in rising prices, especially asset prices through 1996 and into 1997. Real exchange rates were becoming increasingly overvalued due to the exchange rate peg. In addition, diminishing returns to investment and emerging bottlenecks in labor markets resulting in rising real wages (in particular Thailand) further reduced competitiveness. The guarantee of a fixed exchange rate also encouraged borrowing in US Dollars at low interest rates and investment in assets earning high rates of return in local currency (see Krugman (1998) and Hale (1998)). Borrowers believed that the process was sustainable while the central bank accumulated foreign exchange reserves because if necessary these reserves could be used to intervene in the event that the exchange rate weakened. Essentially the foreign exchange risk implicit in the borrowing strategy did not need to be covered because the insurance against an exchange rate fall was provided by the government. However, increasingly the stage was set for an exchange rate crisis when the trend of reserve accumulation reversed. A likely trigger of the crisis was a rise in US interest rates in March 1997 that set in train a sequence of problems that ultimately led to a loss of confidence in a number of countries. The portfolio adjustment that this change in US monetary policy induced globally, was reflected in a withdrawal of funds from Asian economies. The capital

inflows that created problems when flowing into the region created more serious problems when they were reversed because of the fixed exchange rate regimes in place. The first casualty was Thailand who abandoned its pegged exchange rate in July 1997 although pressure on the Thai baht had already lead to a massive loss in foreign exchange reserves by May. Very quickly the exposure of the Thai economy to short term uncovered dollar denominated liabilities was clear. The perceived insurance provided by the Thai government in the promise to maintain the exchange rate and with success until July 1997, meant that little cover was taken on foreign currency liabilities. With capital flowing out of other economies in the region it didn't take long for investors and lenders to question the exposure of other economies as well. Once confidence was undermined the jump in the risk premium on assets in the region caused a full scale currency crisis. The impact of the sudden re-evaluation of risk is the focus of the model simulations in the latter part of this paper.

How could a change in financial markets cause such a dramatic decline in real economic activity? In the modeling framework used in this paper this occurs because the financial and real economies are inexorably linked. In particular, arbitrage between financial assets and the real return on capital when physical capital is fixed in the very short term, implies that a sharp rise in required rates of return on financial assets implies a sharp contraction in the use of physical capital in the economy.

In order to understand the full extent of the adjustment process a general equilibrium framework is essential because there are many complicated processes at work. Indeed many analysts have examined the impact of the Asia crisis on non Asian economies by looking at the

extent of international trade and mapping the projected fall in domestic demand in the Asian economies to a fall in exports from the industrial economies. The fall in exports then equates to a fall in GDP. However the results below show that not only is this misleading but it can in fact give the wrong outcome. A crucial missing ingredient is that the capital outflow from Asia did not evaporate but was reallocated to other non Asian economies. Ignoring this fact misses a key part of the global adjustment story. In order to bring this as well as other general equilibrium factors into the analysis, this paper uses the G-Cubed (Asia-Pacific) model. This model is outlined in section 3. It is derived from the G-Cubed model developed by McKibbin and Wilcoxen (1992, 1995) but with a specific focus on the Asian economies. As with the G-Cubed model, this model captures simultaneously the macroeconomic and sectoral linkages in a global model with partially forward looking asset market and spending decisions in which expectations of risk are integral to the functioning of domestic economies and the global economy. The G-Cubed (Asia Pacific) model has country/regional ids-aggregation of: Korea, Japan, Thailand, Indonesia, China, Malaysia, Singapore, Taiwan, Hong Kong, Philippines, Australia, New Zealand, United States, India, Rest of the OECD, Oil exporting developing countries, Eastern Europe and Former Soviet Union and all other developing countries. Each country/region has an explicit internal macroeconomic and sectoral structure with sectoral disaggregation in production and trade into 6 sectors.

This is a model in the class of dynamic intertemporal general equilibrium models[1] that incorporate both financial and real economic activity in a global framework. This new class of models designed specifically for the highly integrated world economy of the late 20th century,

integrates the desirable features on both macroeconometric models and computable general equilibrium models. This new type of model has proven useful understanding other recent global shocks such as US fiscal policy in the 1980s, the consequences of NAFTA and German Unification2. A key feature of these models is the role of international capital mobility in economic adjustment and the role of financial markets in real economic activity.

Section 4 presents a framework for thinking about how to implement changes in risk perceptions into a model such as the G-Cubed model. This section focuses on two scenarios. It is clear that as of February 1998, the persistence of the shock in Asia is unclear. The shock to risk premiums in the Mexican crisis of 1994 was over in a remarkably short time. Yet given the sequence of policy mistakes currently being experienced by Indonesia, a good case can be argued that the risk of investing in Indonesia will be high for a long period to come. To explore the range of possibilities two extreme shocks are considered in this paper. Reality is likely to lay somewhere between the two and it is left to the reader to use the scenarios to form their own predictions. The first scenario is a sharp rise in the risk premium on assets denominated in the currencies of Thailand, Malaysia, Indonesia and Korea (smaller risk premiums are used for other economies in the region as indicated in section 4 below). The risk premium jumps in the first year and then declines over a period of three years. This is contrasted with a scenario in which the jump in the risk premium is assumed to be permanent rather than temporary. This can be thought of a rise in risk in which the probability that governments will be able to deal effectively with the shock is either low (the permanent case) or high (the temporary case). Both shocks are benchmarked to

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1 Referred to as DIGEM models

2 See Gagnon et al (1997) and McKibbin (1994).

yield the same fall in the nominal exchange rate that we observed in each economy by the beginning of 1998. The goal of this paper is not to predict what will happen in Asia but to draw crucial lessons and improve our understanding of adjustments to the global economy taking account of general equilibrium interdependencies.

Results are presented in section 5 for both simulations. It is clear that a revision of risk can cause large declines in real economic activity which have serious implications for the next few years of economic performance in Asia. The more permanent the risk revision the more severe the consequences. The key reason that the financial shock has such large real implications is because of the role of adjustment costs in physical capital formation. In the G-Cubed model arbitrage between financial assets and physical capital takes into account that physical capital is sector and country specific for significant periods of time whereas financial capital can move extremely quickly across sectors and economies3. The impact on the rest of the world is quite different to that portrayed by most, if not all commentators. The modeling shows that the collapse in economic activity in Asia reduces exports of non Asian economies, but it also reduced global real interest rates which stimulates domestic economic activity especially in interest sensitive sectors in non Asian economies. This stimulus to domestic demand can more than offset the negative impacts of a decline in exports depending on the relative reliance of each economy on domestic demand versus trade with Asia. Indeed the relocation of financial capital would be expected to stimulate an investment boom in non traded production in places like the US and Europe while export sectors in these economies are suffering from the crisis. The differential impacts within

3 See McKibbin and Wilcoxen (1997) for detailed analaysis of the role of adjustment costs in physical capital formation and the implications of this for macroeconomic volatility.

each economy is both sustainable and desirable but will be associated with significant shifts in the current account balances of major economies. Those countries receiving capital from Asia would be expected to experience a deterioration in their current accounts reflecting the capital inflow. Preventing this adjustment would be costly both for the Asian economies that need the temporary export surge to dampen the negative economic shock as well as for the OECD economies that need the additional investment to expand the productive capacity of their economies in the face of stronger domestic demand.

2. The Emergence of the Crisis

Figure 1 shows the extent of changes in nominal exchange rates between 1 January 1996 and 21 January 1998. The massive falls in nominal exchange rates commenced in July 1997 with the Thai baht and followed by each of the other currencies in the chart except the Hong Kong dollar. There were several stages in the collapses which differed by country reflecting different policy responses in each country. By the end of January 1998 the Indonesian rupiah had fallen most sharply by around 80% relative to the level just 7 months earlier.

In understanding the lead up to the crisis it is worth looking at both what informed commentators on the countries were writing in the lead up to the crisis as well as to look at actual data that incorporated agents expectations of future economic activity. A good source of commentary on the region is the annual "Asia Pacific Profiles" published by the Asia Pacific Economics Group (see APEG (1996,1997)). The volumes published in early 1996 and early January 1997 pointed to a raft of country specific problems ranging from corruption to asset price

bubbles and sharply rising real wages especially in Thailand. Nonetheless the authors did not predict crisis but signs of emerging problems that would retard economic growth. Similarly Paul Krugman (1994) in his highly publicized article on the Asian growth miracle pointed out that evidence suggested that economic growth in Asia was due primarily to accumulation of factors rather than technical change and therefore, with diminishing returns to factor accumulation, growth was likely to slow. Neither these authors nor a range of others who have researched the Asian economies forecast the extent of decline in these economies. Part of the reason is not that the researchers didn't understand the Asian economies but more likely that the eruptions from July 1997 were the result of a large unpredicted shock rather than being the natural outcome of a smooth process of adjustment. The results presented below support this hypothesis.

As well as looking at the outlook of researchers before the crisis, other useful sources of information are the rating of debt by international ratings agencies, the spreads on foreign loans to the region as well as the local stock market indexes. The data on rating agencies is analyzed in Radelet and Sachs (1998). The authors clearly show that there was no change in ratings by either Moody's or Standard and Poors as late as June 24, 1997. Equally the spreads on foreign lending to these economies did not reflect the crisis until it was underway. However the stock indexes did portend of emerging problems.

Figure 2 contains daily data on key stock market indexes for a number of countries from 1 January 1996 to early 1998. It also contains three periods indicated by vertical lines (with arrows) during which time US interest rates were rising (specifically in dating these changes I use the yield on 5 year US government bonds). The first important information contained in this graph is that,

in contrast to many popular perceptions, the stock markets where already pricing problems in economic activity in both Thailand and Korea from early to mid 1996. The decline in the Thai and Korean stock markets followed a period of gradually rising US interest rates between February and early April 1996 (the yield on 5 year US bonds rose from 5.14% on 2/9/96 to 6.5% on 4/8/96). Not only was the share market not rising as quickly as other markets in these economies but it was actually trending down during most of the period. In addition to the pessimism reflected in the stock markets, there was increasing concern and wide spread debate on the fall in export growth during 1996 in all economies in the region. This was a focus of the Asia Pacific Profiles.

Another key piece of information contained in figure 2 is the way in which the crisis emerges in the stock market data earlier than in the foreign exchange market obviously because governments were intervening in the foreign exchange markets. In particular there are two periods in which the stock markets of crisis countries dropped sharply. The first began in March 1997 the second in August 1997. Most importantly all stock market indexes dropped at the same time. The US index fell 8 percent during March and early April 1997. This coincided with a rise in official US interest rates of 25 basis points on March 25 (although the yield on 5 year bonds rose from 6.09% on 1/29/97 to 6.83% on 4/7/97). The period of rising interest rates was associated with a fall in all stock markets. While the US market eventually recovered, as did other countries in the chart, the markets of Thailand, Malaysia and the Philippines continued to fall. By July 1997 the exchange rate of those countries were floated. The second episode of rising interest rates and falling stock markets was in August 1997. During August there was considerable speculation that

US interest rates would rise again. Between 7/25/97 and 8/19/97 the yield on 5 year bonds rose from 6.06% to 6.27%. This was building in an expected rise in official interest rates at the August Federal Reserve Board meeting however this did not eventuate and interest rate quickly dropped again. During the period of rising interest rates, Wall St fell again in anticipation. The adjustment in stock markets occurred in all countries. Again most countries recovered however, this time Indonesia and Hong Kong markets continued to fall and a temporary recovery in both Korean and Thai stock markets was reversed. The instability in August was ultimately followed by a float of the exchange rate in Indonesia and extraordinarily high interest rates in Hong Kong in defense of the Hong Kong exchange rate.

The trigger for the crisis had thus been pulled and by the end of August, risk premia were rising in countries with apparently high exposure to large exchange rate changes. Capital flowed out of the region which lead to large depreciations in regional exchange rates. The resulting imbalance in bank and corporate balance sheets with liabilities rising in proportion to the exchange rate falls and assets sinking as economic growth stalled lead to financial problems which lead to a freezing up of the domestic financial systems, very similar to the financial crises of the Great Depression in the 1930s. Keynes taught us that the appropriate policy response in the face of financial panic was a relaxation of monetary policy to maintain liquidity and a relaxation of fiscal policy to maintain real demand in the face of declines in private investment and consumption. Instead, with the encouragement of the IMF, countries tightened monetary policy and fiscal policy. The effect was to turn the financial crisis into a serious economic collapse. On top of this, the policy response in countries varied significantly with some measure of confidence restored in

Korea and Thailand by early 1998 but further loss of confidence in Indonesia.

The various weights that readers will place on particular country issues will vary but it is clear for whatever reason, the risk of investing in Asia has risen. What are the implications of this type of shock? This is the focus of section 4 below.

3. A General Equilibrium Multi-Country Framework: The G-Cubed (Asia Pacific) model

In order to put the Asia crisis into a global perspective a multi-country general equilibrium model is required. The G-Cubed (Asia Pacific) multi-country model is based on the G-Cubed model developed in McKibbin and Wilcoxen (1992, 1995). It combines the intertemporal macroeconomic approach taken in the MSG2 model of McKibbin and Sachs (1991) with the disaggregated, econometrically-estimated, intertemporal general equilibrium model of the U.S. economy by Jorgenson and Wilcoxen (1989).

The G-Cubed model was constructed to contribute to the current policy debate on global warming, trade policy and international capital flows, but it has many features that make it useful for answering a range of issues in environmental regulation, microeconomic, macroeconomic and trade policy questions. It is a world model with substantial regional disaggregation and sectoral detail. In addition, countries and regions are linked both temporally and intertemporally through trade and financial markets. The explicit treatment of financial flows has been shown to be important for analyzing the response to trade liberalization (see McKibbin(1997)) but it is absolutely crucial for analyzing the consequences of financial shocks such as the re-evaluation of

risk. G-Cubed contains a strong foundation for analysis of both short run macroeconomic policy analysis as well as long run growth consideration of alternative macroeconomic policies.

Intertemporal budget constraints on households, governments and nations (the latter through accumulations of foreign debt) are imposed. To accommodate these constraints, forward looking behavior is incorporated in consumption and investment decisions. Unlike the MSG2 model, the G-Cubed model also contains substantial sectoral detail. This permits analysis of environmental and trade policies which tend to have their largest effects on small segments of the economy. By integrating sectoral detail with the macroeconomic features of the MSG2 model, G-Cubed can be used to consider the long run costs of alternative environmental regulations and trade policy changes yet at the same time consider the macroeconomic implications of these policies over time. The response of monetary and fiscal authorities in different countries can have important effects in the short to medium run which, given the long lags in physical capital and other asset accumulation, can be a substantial period of time. Overall, the model is designed to provide a bridge between computable general equilibrium models and macroeconomic models by integrating the more desirable features of both approaches. The G-Cubed (Asia Pacific) model differs from the G-Cubed model because of the focus on the Asia-Pacific region as well as having 6 sectors compared to 12 for G-CUBED. The theoretical structure is essentially the same.

The key features of the G-Cubed (Asia Pacific) model are summarized in Table 1. The country and sectoral breakdown of the model are summarized in Table 2. The model consists of eighteen economic regions (the new version (29) used in this paper also includes India and New Zealand) with six sectors in each region (there are also two additional sectors in each region that

produce the capital good for firms and the household capital good). The regions in the model can be divided into two groups: 15 core countries/regions and three others. For the core regions, the internal macroeconomic structure as well as the external trade and financial linkages are completely specified in the model.

Each core economy or region in the model consists of several economic agents: households, the government, the financial sector and the 6 production sectors listed in table 2. Each of these economic actors interact in a variety of markets, both domestic and foreign.

The eighteen regions in the model are linked by flows of goods and assets. Flows of goods are determined by import demands for final consumption as well as for intermediate inputs. Trade imbalances are financed by flows of financial assets between countries. It is assumed (based on calibrating the model to a 1996 base year) that existing wedges between rates of return in different economies are generated by various restrictions that generate a risk premium on country denominated assets. These wedges are calculated using a technique outlined in section 4 below. They are assumed to be exogenous during simulation. Thus in general when the model is simulated, the induced changes in expected rates of return in different countries generate flows of financial capital reacting to return differentials at the margin. In this paper I also explore the impact of changing these wedges in some countries primarily as a result of risk re-evaluation. These can also be used to explore the consequence of financial liberalization (see McKibbin (1997)).

International capital flows are assumed to be composed of portfolio investment, direct investment and other capital flows. These alternative forms of capital flows are perfectly

substitutable ex ante, adjusting to the expected rates of return across economies and across sectors. Within an economy, the expected return to each type of asset (i.e. bonds of all maturities, equity for each sector etc) are arbitraged, taking into account the costs of adjusting physical capital stock and allowing for exogenous risk premia. Because physical capital is costly to adjust, any inflow of financial capital that is invested in physical capital (i.e. direct investment) will also be costly to shift once it is in place. The decision to invest in physical assets is based on expected rates of return. However, if there is an unanticipated shock then ex-post returns could vary significantly. Total net capital flows for each economy in which there are open capital markets are equal to the current account position of that country. The global net flows of private capital are constrained to zero.

4. Modeling the Asia Crisis

This section sets out two scenarios for understanding the impact of a re-evaluation of risk on Asian economies. Before presenting how this is done it is useful to set out how the baseline of the model is generated without the shocks to risk. The model is first solved from 1996 to 2070 to generate a model baseline based on a range of assumptions. These assumptions include assumptions about population growth by country (based on World Bank projections) and sectoral productivity growth by country by sector (based on a technology catch-up model) as well as assumptions about tariff rates, tax rates, and a range of other fiscal and monetary policy settings. Monetary policy is assumed to be targeting a stock of nominal money balances in each economy. Fiscal policy is defined as a set of fixed tax rates (apart from a lump sum tax on households that

varies to satisfy the intertemporal budget constraint facing the government) and government spending constant relative to simulated GDP. The issue of projecting the future using a dynamic intertemporal general equilibrium model such as the G-Cubed model, is discussed in detail in Bagnoli et al (1996). This initial projection step is important for simulations because it builds in underlying structural change in the global economy which is endogenous to the exogenous assumption about differential productivity growth.

Given all of the exogenous assumptions and initial conditions the full rational expectations solution of the model is found using a numerical technique outlined in Appendix C of McKibbin and Sachs (1991). Without additional intervention, this initial model solution will not generate the actual outcomes for the first year of simulation (in the current example 1996) because a range of forward looking variables such as human wealth, exchange rates, stock markets etc will be conditioned on the future path of the world economy and there is no reason these should be equal to the observed values for the initial year. The next step of baseline generation is then to calculate a vector of constants for all equations in the model, including arbitrage equations, such that the solution of the model in the base year (1996) is exactly equal to the observed data in that year. It is important to stress that in no way are we assuming that 1996 is a steady state solution of the model. It clearly cannot be. What we are imposing is that the 1996 database is on the stable manifold of the model in which all variables are moving on a stable path towards a steady state in the long distant future.

To see more precisely what the technique does and how a re-evaluation of risk is modeled, consider the uncovered real interest parity assumption relating the returns to government debt in

each country, that is used in the model. This is shown in equation (1).

$$r_t^i = r_t^U + {}_t e_{t+1} - e_t + \xi_t \qquad (1)$$

Here the real interest rate (r) on 1 year government bonds in country i in period t is equal to the interest rate in the United States (r^U) in period t, plus the expected rate of depreciation in the bilateral real exchange rate between country i and the United States (${}_t e_{t+1}$-e_t) where e_t is the log of the real exchange rate in period t and ${}_t e_{t+1}$ is the expectation, formed in period t, about the exchange rate to prevail in period t+1. In addition we assume that there is a risk premium ξ which if positive means that country i interest rates on government debt (in real terms) are above the interest rates on comparable US government debt expressed in the same currency. In principle this risk premium varies over time.

The term ξ captures a range of issues including sovereign risk, impediments to financial flows, the degree of departure from rational expectations in actual data as well as a range of other factors.

Equation 1 can also be interpreted differently. Solving for e_t it can be shown that:

$$e_t = \int_t^T (r_s^U - r_s + \xi_s)\, ds + {}_t e_T \qquad (2)$$

The real exchange rate in any period t is the sum of future expected interest rate differentials as well as the expected future risk premium on assets denominated in the home

currency plus the equilibrium (period T) value of the real exchange rate.

In the baseline we calculate a constant value for ξ such that the exchange rate (e) converted into nominal terms using the appropriate price deflators in 1996 is equal to the observed nominal exchange rate. In practice this calculation can be done using actual data outside the model as long as some measure of the expected change in the exchange rate can be found. In this paper the model is used to calculate the expected change in the real exchange rate. It is also important to stress that although the arbitrage relation outlined above focuses on the bond rate differential, recall that within each economy all financial assets (bonds, money, equity etc) are being arbitraged and therefore there is a wedge across all assets. In addition changing the wedge between bond rates will also affect the relative returns of a range of domestic and foreign assets that are being arbitraged to the yield on government bonds.

In the simulations that follow a path is selected for the expected future risk premium. This is completely arbitrary so two scenarios are chosen. The first is a rise in the risk premium that lasts for 3 years before returning to baseline. The second is a rise in the risk premium which lasts forever. The values of the risk shock are selected such that the model generated change in the nominal exchange rates are equal to the observed changes in nominal exchange rates as of December 1997. Whether the actual risk shock that is being priced in current exchange rates is permanent or temporary is difficult to determine at this stage. To the extent that it is affected by government responses to the crisis, it is likely that the risk premium for Indonesia is looking more permanent daily whereas for the other countries a declining shock seems reasonable. The reader can use the results to generate their own forecasts.

It is also worth stressing that from equation (2) we can choose any path for ξ and get the same exchange rate for the first year of the simulation for given paths of interest rates. However over time the path of the risk premium will have a very different impact on the real exchange rate path.

5. Simulation Results for the Asia Crisis

The first simulation is a temporary shock to the risk premium as outlined above. The exact shock is set out in table 3. In addition to the change in risk premia in each country, we also introduce a monetary shock for Indonesia to capture the effects of the sharp growth in money in January 1998. In addition for each country which required an IMF program I shock total factor productivity in each sector to capture the effects of a financial sector crisis. The one exception is Malaysia where an IMF program has so far not been required but in which a smaller productivity shock is introduced. The size of these shocks are arbitrary but are meant to go someway towards replicating the actual experience in these economies.

a. Temporary Shock

The results for a temporary increase in risk with a financial crisis are contained in figures 3 through 12. All results are expressed as percent deviation from baseline except where noted.

Figure 3 contains results for nominal exchange rates in a number of economies. The rise in risk and fall in productivity leads to a large outflow of financial capital. This outflow depreciates the

nominal and real exchange rates by between 18% and 75% through 1998. The exchange rates recover over time reflecting the restoration of confidence in each economy. The outflow of capital also leads to a sharp rise in real interest rates in each economy and a general deflation of asset prices. Figure 4 illustrates the change in the stock market value of industries in the non-durable manufacturing sector in each economy. The rise in real interest rates, decline in wealth and sharp reduction in expected future incomes leads to a sharp drop in domestic demand. The is illustrated in figure 5 for consumption and figure 6 for investment. According to the model, consumption falls by over 60% in Indonesia through 1998. Investment falls by up to 40% during 1998. This sharp contraction in economic activity reflects the large capital losses experienced by residents of these economies. In particular the fixity of physical capital implies a significant reduction in capital use given the large increase in the cost of capital.

Despite the large contraction in domestic demand, gross domestic product (GDP) is not quite so badly hit as shown in figure 7. These economies are able to maintain production in the face of a sharp drop in domestic demand because of the adjustment in exports shown in figure 8. The sharp depreciation in the nominal and real exchange rate increases the demand for products from the Asian economies in non Asian economies. This sharp export surge is consistent with the change in the balance of payments reflecting a capital outflow. A capital outflow is associated with a current account surplus. This can be achieved either by a rise in exports or a fall in imports. The model projects that this adjustment occurs through a large rise in exports and small fall in imports. In early 1998 it appears that the actual adjustment is not occurring through exports but rather through a sharp drop in imports. This largely reflects the collapse of the domestic and international

financing of international trade. Given the recovery in each economy, apart from Indonesia, it is expected that the model projection will be closer to being realized over the coming few months.

The effects on Asia are large. What are the effects on the rest of the world? Many analysts calculate this using a back of the envelope calculation which entirely relies on the flow of trade between economies before the crisis. The fall in domestic demand signals a fall in demand for imports from non Asian economies and therefore a decline in growth from these economies in rough proportion to the decline in Asian domestic demand. The first indication that this may be less than accurate is the already alluded to results above that the change in domestic demand does not necessarily translate into the same fall in output given the export response. Thus if a country is exporting goods to Asia not for domestic demand but as inputs into products that are largely exported from Asia, the change in the demand for that countries goods is not likely to reflect the fall in domestic demand in Asia. More important is the fact that such a partial analysis ignores completely the general equilibrium effects of the large shifts in international capital flows that are a crucial part of the Asian crisis. The model in this paper captures these effects.

Figure 9 contains the results for the change in the Australian and US current account balances (expressed as a percent of GDP). The deterioration in the current account balances of both countries reflect the capital that flows into these economies out of Asia. As capital flows into the United States and Australia the real exchange rate of each economy tends to appreciate which reduces exports and increase imports. Indeed the rise in Asian exports is accommodated by this change in imports in non Asian economies. The Australia dollar strengthens relative to the Asian currencies but depreciates relative to the US dollar. In the short term there is a depreciation of

around 1.7% (to be discussed in relation to figure 18 below). This is not as large as was actually experienced in the early stages of the crisis. The reason that the Australia dollar depreciates relative to the United States is because Australia is more exposed through trade with Asia than is the United States and therefore the equilibrium real exchange rate for Australia is relatively depreciated compared to the United States. The depreciation is offset however by the capital inflow into Australia which tends to appreciate the Australia dollar.

The importance of this capital inflow is shown next in figure 10. This figures shows both Australian and United States exports and investment. As expected the fall in demand in Asia is reflected in a fall in exports from both countries of 10% for the United States and 18% for Australia. Investment on the other hand rises by close to 5% in each economy. The fallout from the Asia crisis includes a fall in global long term interest rates. This fall in interest rates stimulates domestic economic activity outside of the export industries in these economies. Thus whether GDP will rise or fall in the United States and Australia depends on whether the negative demand shock from lower exports is more or less important than the positive demand shock from higher investment spending resulting from lower long term real interest rates. Figure 11 shows that in the case of the temporary shock, the effect in the very short term is negative on balance but more so for Australia (GDP is lower by 0.25%)because of the greater reliance on trade with Asia relative to the trade reliance of the United States. The results for GDP shown in figure 11 show the reallocation of production in the global economy since GDP is a measure of value added by domestically located factors of production. A better measure of welfare in reflected in income changes rather than production location. Gross National Product (GNP) is the income earned by

domestic residents on all factors of production owned by domestic residents either located domestically or overseas. The results for GNP are shown in figure 12. GNP falls in the short term but then rises for several years before being permanently lower. The relocation of capital increases production in the US but the capital owned by US residents now earns a lower rate of return than it would have earned in the previously high return Asian economies. Thus although GDP rises over time, GNP is permanently reduced for non Asian economies. A rise in risk thus reduced world income even though it can raise production in some countries while lowering it in others. The fact that physical capital is difficult to move in the short run means that there are capital losses that are permanent. In other words, the Asia crisis is not good for the world economy as a whole despite what it may do for the location of production.

Permanent Shock

The results for the permanent rise in risk (with the same short term productivity shocks) are shown in figures 13 through 21. The adjustment in the short term is essentially the same as for the temporary shock – capital flows out of the Asian economies depreciating the real exchange rate and leading to a collapse in domestic demand. There are however some important differences that emerge over time.

Figure 13 shows the path of the nominal exchange rates over time. In contrast to the temporary shock, the exchange rate remain below baseline for decades. The real exchange rate (not shown) is similar to that for the temporary shock but in the case of the permanent shock the changes in inflation in these economies are relatively larger which offset the impact of a more

depreciate nominal exchange rate. In figure 14 it is clear that the initial drop in consumption is similar to the temporary shock however the persistence of the consumption loss in much longer indicating a more severe economic crisis. Investment (figure 15) is also quite different. The decline in investment is larger and remains permanently reduced. The permanently higher risk implies a permanently lower capital stock (permanently higher marginal product of capital relative to the rest of the world reflecting the risk premium) in these economies and therefore a lower steady state rate of investment needed to support it. The permanently lower capital stock is clearly reflected in a permanently lower real GDP in figure 16. The short run real GDP losses are much larger for the permanent versus the temporary shock even though the exchange rate changes are normalized to be very similar. The long run effects are also much larger for the permanent shock. The export stimulus is also much more sustained in the case of the permanent shock. This also is reflected in a more sustained rise in current account surpluses (fall in deficits). Thus even normalizing the initial exchange rate shock to be the same the real consequences of the change in risk is quite different initially depending on what is expected about future adjustment of policy.

A comparison between the permanent and temporary shocks on the Australia dollar are shown in figure 18. In the temporary case, the drop in the exchange rate is a third of the drop under the permanent shock. For the permanent shock, the change in the long run real exchange rate for Australia is much larger because of the permanent fall in demand for Australia products from Asia. Recall from the intertemporal definition of the exchange rate given in equation 2, the larger the long run real exchange rate depreciation, the larger the short run real exchange rate depreciation. Thus the more permanent the shock the more negative the shock is for Australia

relative to the United States. The impact of the more permanent shock also shows up in the impacts on Australian and US exports and investment. Note from figure 19 that Australian investment rises by less in the short run but is more sustained for the permanent shock. The smaller initial rise is due to the negatives of the permanent shock on Australia's exports and terms of trade which acts to retard somewhat the investment response. For the US the opposite is true.

The results for Australian and US GDP are also quite different in the short run and the long run when the shock is expected to be permanent. For Australia the fall in GDP in the permanent shock is now less than 0.05% whereas for the temporary shock it was close to 0.25%. In contrast US GDP actually rises throughout for the permanent shock because the investment response now clearly dominates the exports loss. In the longer term, real GDP is permanently higher for both Australia and the United States as a result of the relocation of capital. The short run flows of financial capital eventually result in changes in long run physical capital location.

This does not mean that Australia and the United States are better off as a result of the Asia crisis because the GDP results purely reflect the location of industry not the income from production. This is clearly illustrated in figure 21 in which GNP is shown. The relocation of capital does lead to a short run Keynesian stimulus in Australia and the United State as new capital is built but over time the income from the relocation is gradually reduced. This occurs because after the business cycle stimulus the returns to capital are lower in the US and Australia relative to what they would have been in Asia. Thus overall income flows fall even though production is higher in the non-Asian economies. In this model all people own both capital and labor and therefore nothing can be said about the distribution of income within the non –Asian

economies. In the model the returns to capital fall but the returns to labor rise in non Asian economies which is reflected in higher real wages. Workers have a higher physical capital stock to work with and since labor is immobile the gains to labor accrue as higher income to labor.

5. Conclusion

This paper has explored the global implications of the economic crisis in Asia focusing on the consequences for international trade and capital flows of a change in the perceived risk of investing in the Asian economies. A number of factors related to domestic institutions and fixed exchange rate regimes were identified as creating the seeds of a crisis that eventually caused a rise in the perceived risk of investing in Asia with large real economic consequences. The model forming the basis of this study takes the underlying explanation of risk as exogenous which is unsatisfactory in one sense because the phenomena that we attempt to understand is external to the model. Nonetheless taking the change in risk as the external shock does allow some useful analysis of what might be expected to occur now that the shock has happened. In particular several lessons can be learned from this paper.

The first is that a financial shock can quickly become a real shock because of the interdependence of the real and financial economies. Too often policymakers and modelers ignore this interdependence. The reaction of policymakers directly, and in the implications for risk of their responses are crucial to the evolution of the crisis. We know far too little about the determinants of risk but the impacts of changing risk perceptions pointed to by this paper appear to be large.

One implication of the approach taken in this paper is that the re-evaluation of risk and subsequent capital outflows lead to severe economic disruption. Is the conclusion that countries should act to slow movement of international financial capital? The framework for thinking about exchange rate determination used in this paper suggest this could be a very expensive strategy to follow. To model restrictions on capital flows or a "Tobin tax" on capital transactions in the model used here is exactly the same as a rise in ξ (increasing the risk premium on investment in a country). In a forward looking view of exchange rate determination where the expected rate of return on alternative activities is the determinant of the exchange rate, a Tobin tax or any capital flow impediments (or an expected capital flow impediment) has exactly the same implications as the experiments that form the basis of this paper. A large real exchange rate depreciation could be expected as markets adjust for the changes in expected rates of return differentials allowing for the impediment. The alternative which appears more likely to succeed is to allow free mobility of financial capital but to improve the way in which domestic financial systems allocate capital within the economy. This includes improving systems of accountability, transparency in accounting systems, and monitoring of financial systems so a better evaluation of risk can be formulated. For every country that experienced an economic crisis after the exchange rate crisis there are other countries such as Taiwan, Singapore, Australia and New Zealand that were able to survive the turbulence because of relatively recent improvements in their domestic financial systems. In particular, the crisis in Asia has illustrated an important lesson that government acting as insurer (either ex-ante or ex-post) for a wide range of economic activities especially exchange rate risk is a hazardous exercise.

The results in this paper can also be stood on their head and reinterpreted (as they are in McKibbin (1998)) that a reduction in the impediments to financial flows have the potential for large gains in real economic welfare through the benefits of high rates of capital accumulation. With this potential gain, in conjunction with appropriate risk management through appropriate insurance markets rather than through direct government control, potentially significant gains can be realized from closer financial integration of the world economy.

The other key and more pressing policy issues that emerge from the results in this paper relate to the extent to which the output effects within the Asian economies of the collapse in domestic demand are able to be buffered by a rise in exports to the rest of the world. This occurs in the model because it is possible to get the exports out of these economies and into other economies. In fact there are severe problems particularly in Indonesia with both the lack of domestic credit inhibiting exports and the problem of non acceptance of letter of credit issued by Indonesian importers. Without the mechanisms for expanding exports (implicit in the model results), an alternative equilibrium is one of no export growth but massive import contraction. This outcome would, in contrast to the results in this paper, imply both a collapse of domestic demand and a collapse of domestic supply. If this is to be avoided urgent attention must be given to getting the financial system back to performing its crucial role of credit allocation. The proposals for a Resolution Trust Corporation style solution suggested by Litan (1998) for resolving bankruptcies and restoring confidence in the financial systems are crucial. In addition a mechanism for insuring letters of credit in the global trading system is urgently needed.

The other issue is whether non Asian economies will allow the rise in cheap exports from

Asia into their economies. It was shown above that the current account implications of the capital flows are relatively large, with the US current account projected to deteriorate by about 1 percent of GDP over 1998 and the Australian current account projected to deteriorate by over 2% of GDP during 1998. Similar magnitudes would be expected for other non Asian economies. Attempts to prevent this adjustment would be counterproductive to the Asian economies since the export adjustment is crucial for buffering the collapse in domestic demand. It would be counterproductive for the non Asian economies since the reason why the spillover effects from the Asian crisis are small in the model results is precisely because the capital inflow (which is the current account deficit) reduced long term real interest rates in these economies and sustains continued strong economic activity. Preventing the current account deterioration would worsen the export loss by worsening the economic outcome in Asia as well as reduce the domestic investment stimulus in economies outside Asia.

This paper is not intended to forecast the evolution of the crisis in Asia over the next few years but it does provide some insights that are important for policymakers and commentators to absorb. The most important is that international capital flows change the standard analysis of spillovers between countries based on trade flows. Assuming a significant negative impact of the Asia crisis on non Asian economies could indeed be self fulfilling since risk perceptions could rise in non Asian economies because of continual projections that the worst is yet to come. This pessimism could easily retard private investment and could lead to very different outcomes than those found in the model results reported in this paper. As of March 1998, the impacts of the crisis in Asia in both Australia and the United States continue to surprise the partial equilibrium

analysts.

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Table 1: Summary of Main Features of AP-G-CUBED

- Specification of the demand and supply sides of economies;
- Integration of real and financial markets of these economies with explicit arbitrage linkage real and financial rates of return;
- Intertemporal accounting of stocks and flows of real resources and financial assets;
- Imposition of intertemporal budget constraints so that agents and countries cannot forever borrow or lend without undertaking the required resource transfers necessary to service outstanding liabilities;
- Short run behavior is a weighted average of neoclassical optimizing behavior based on expected future income streams and Keynesian current income;
- The real side of the model is dis-aggregated to allow for production of multiple goods and services within economies;
- International trade in goods, services and financial assets;
- Full short run and long run macroeconomic closure with macro dynamics at an annual frequency around a long run Solow/Swan/Ramsey neoclassical growth model.
- The model is solved for a full rational expectations equilibrium at an annual frequency from 1996 to 2070.

Table 2: Overview of the AP-G-CUBED Model

Regions:	***Sectors***:
United States	Energy
Japan	Mining
Australia	Agriculture
New Zealand	Non Durable Manufacturing
Rest of the OECD	Durable Manufacturing
India	Services
Korea	
Thailand	
Indonesia	
China	
Malaysia	
Singapore	
Taiwan	
Hong Kong	
Philippines	
Oil Exporting Developing Countries	
Eastern Europe and the former Soviet Union	
Other Developing Countries	
Agents	***Markets***:
Households	Final Goods
Firms	Services
Governments	Factors of production
	Money
	Bonds
	Equities
	Foreign Exchange

Table 3: Time Profiles for the temporary shock

Country	Variable	1998	1999	2000	2001
Indonesia	Money	5	5	5	5 forever
	Productivity	-9	-6	-3	0 forever
	Risk	30	20	10	0 forever
Malaysia	Productivity	-4	-2	0	0 forever
	Risk	20	20	10	0 forever
Thailand	Productivity	-6	-4	-2	0 forever
	Risk	20	20	10	0 forever
Korea	Productivity	-6	-4	-2	0 forever
	Risk	20	20	10	0 forever
Japan	Risk	6	4	2	0 forever
Philippines	Risk	20	20	10	0 forever
Singapore	Risk	16	8	0	0 forever
Taiwan	Risk	20	14	7	0 forever

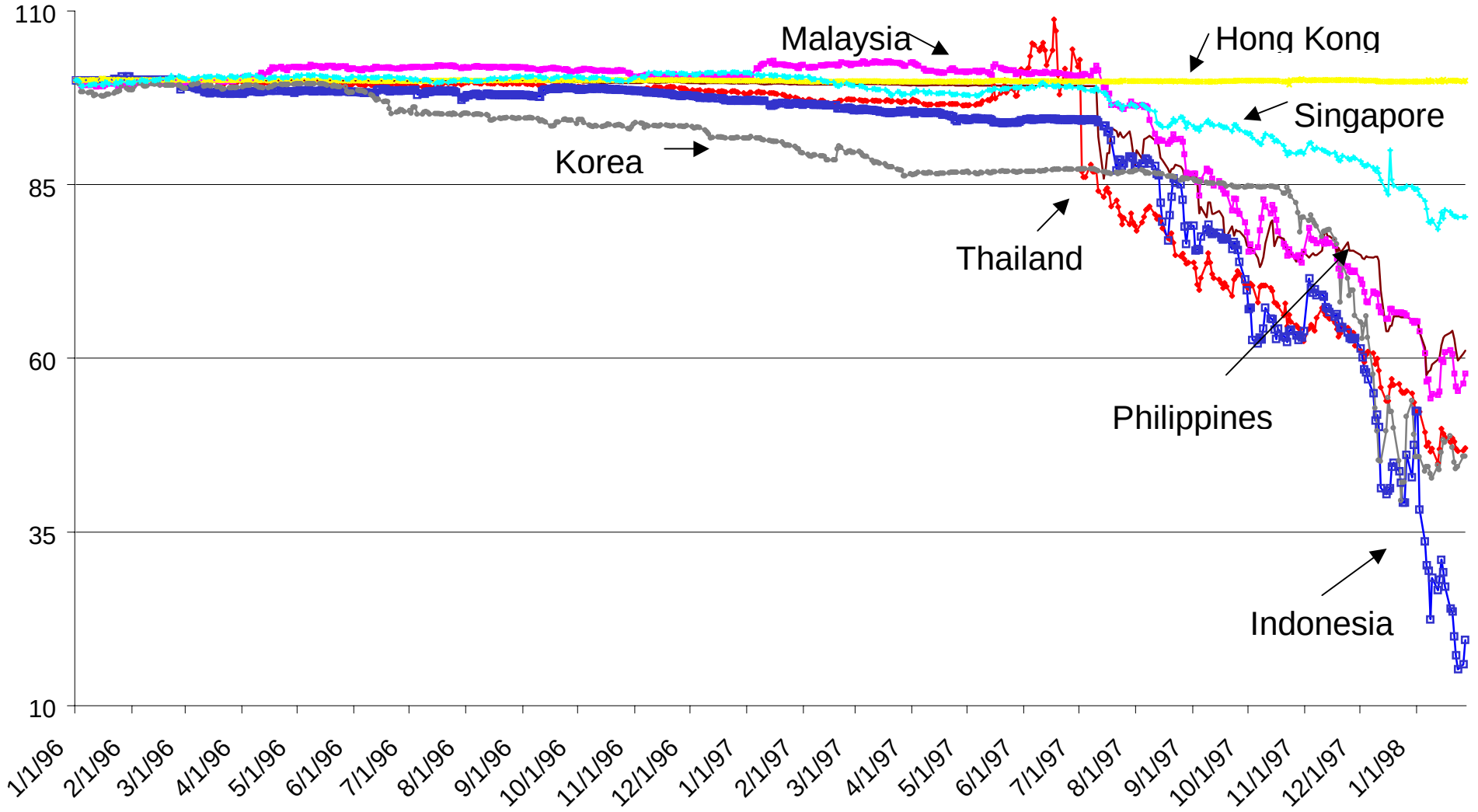
All units are percentage change relative to base.

Table 4: Time Profiles for the permanent shock

Country	variable	1998	1999	2000	2001
Indonesia	money	5	5	5	5 forever
	productivity	-9	-6	-3	0 forever
	risk	5	5	5	5 forever
Malaysia	productivity	-4	-2	0	0 forever
	risk	4	4	4	4 forever
Thailand	productivity	-6	-4	-2	0 forever
	Risk	4	4	4	4 forever
Korea	Productivity	-6	-4	-2	0 forever
	Risk	4	4	4	4 forever
Japan	Risk	1	1	1	1 forever
Philippines	Risk	4	4	4	4 forever
Singapore	risk	1	1	1	1 forever
Taiwan	risk	4	4	4	4 forever

All units are percentage change relative to base.

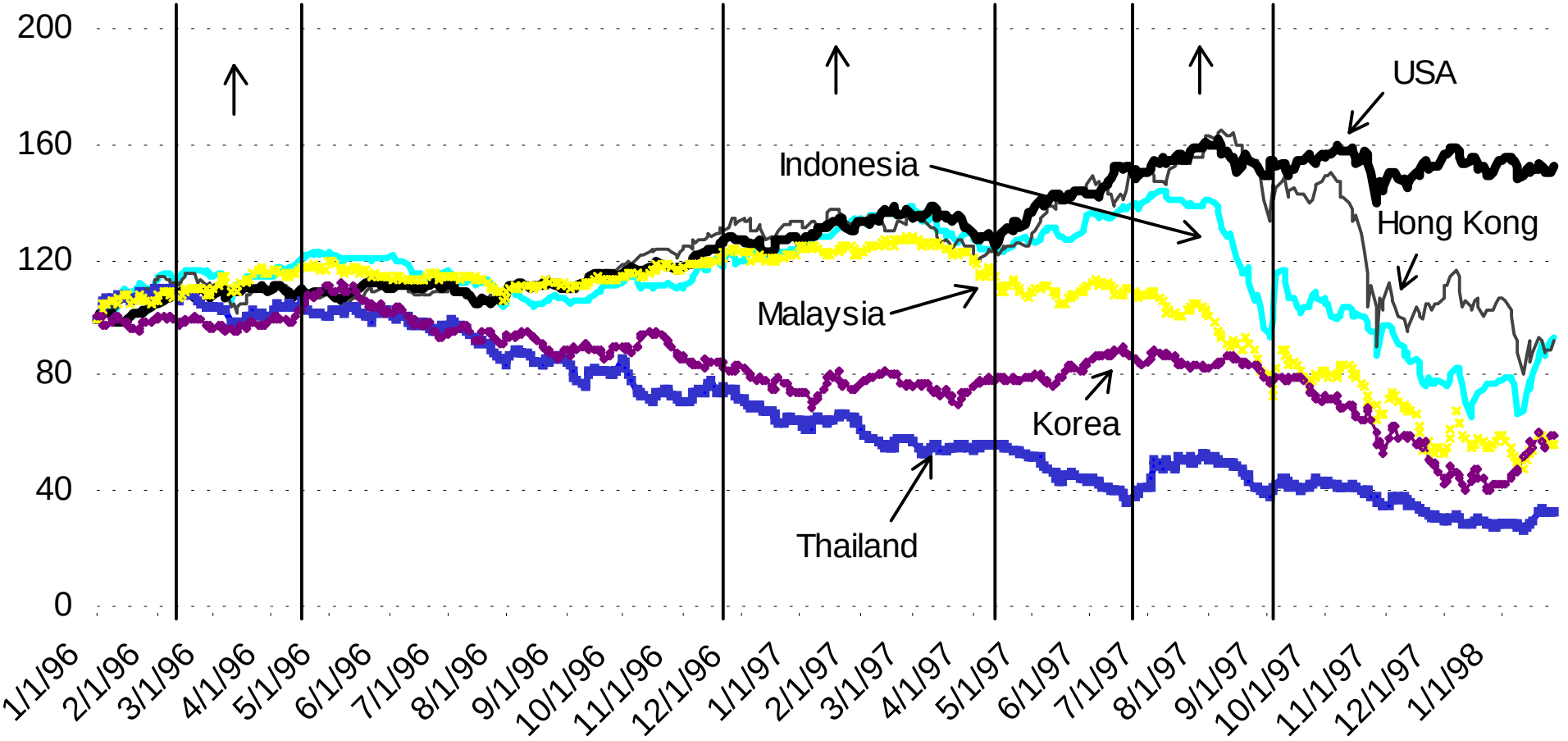
Figure 1: Exchange Rates $US per local currency (1996=100)



Source: National Australia Bank

Figure 2: Stock Market indexes for Selected Markets

(1 January 1996=100)



Source: Data from National Australia Bank

Figure 3: Change in Exchange Rates due to Temporary Loss in confidence (depreciation is down)

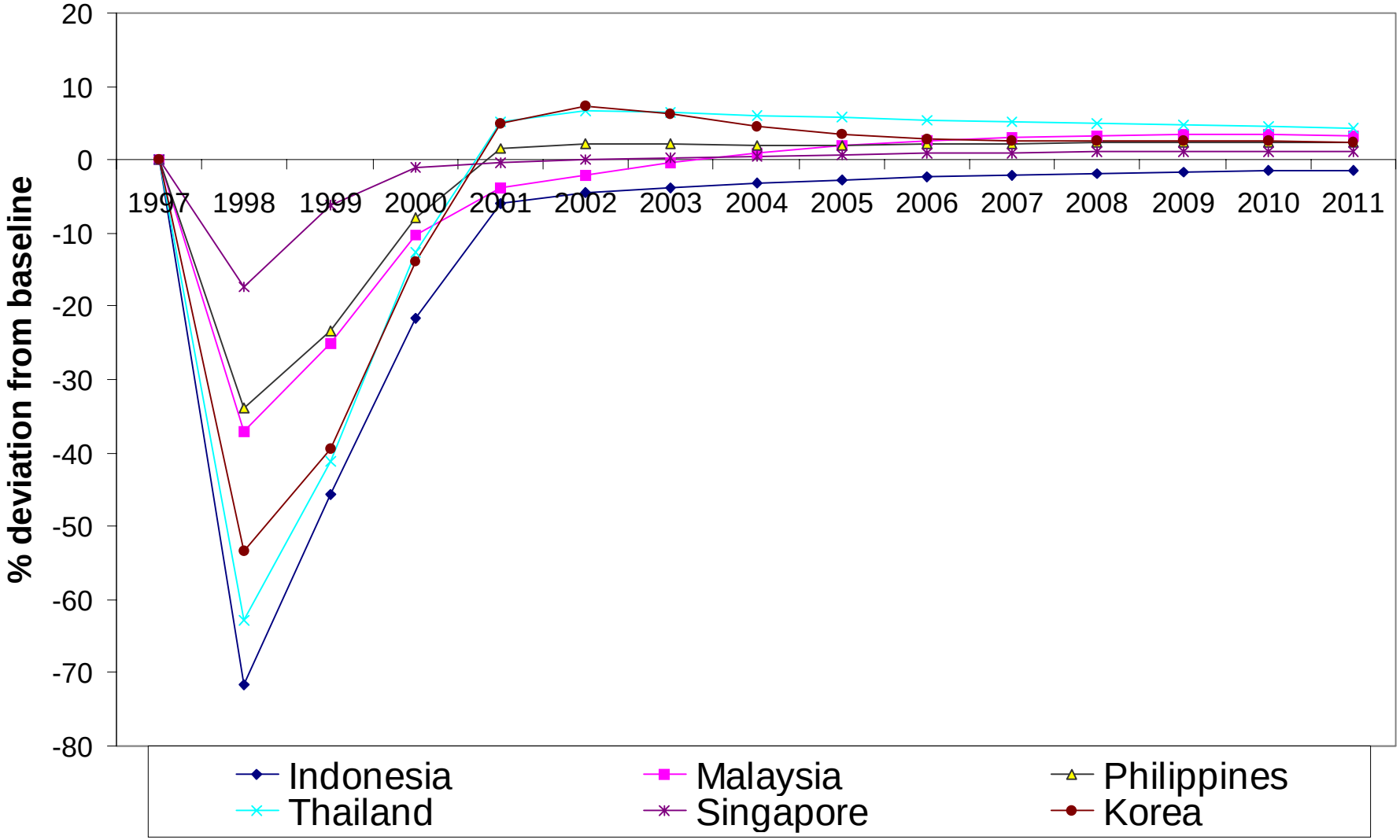


Figure 4: Change in Stock Market Value of Manufacturing due to Temporary Loss in Confidence

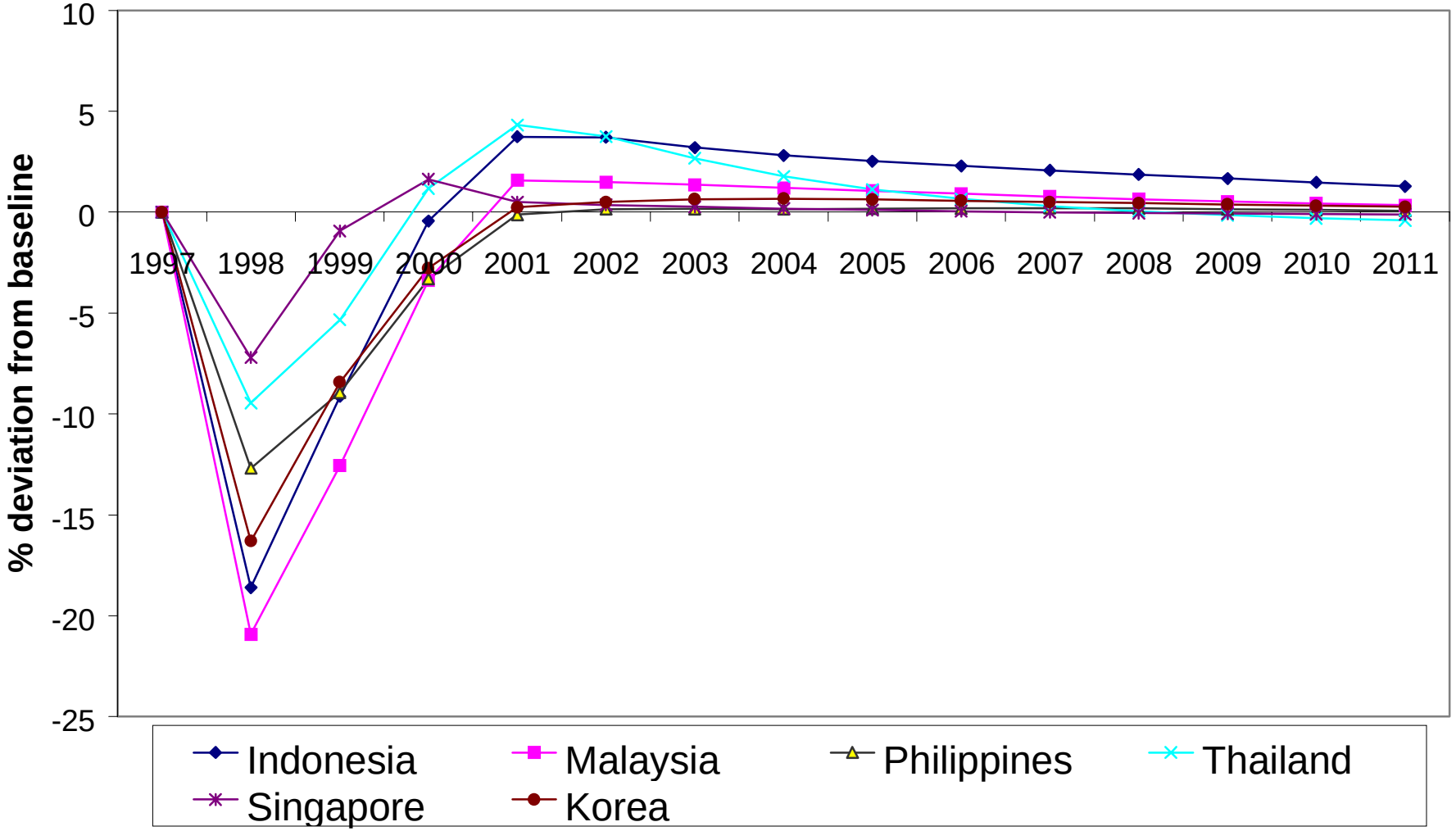


Figure 5: Change in Private Consumption due to Temporary Loss in Confidence

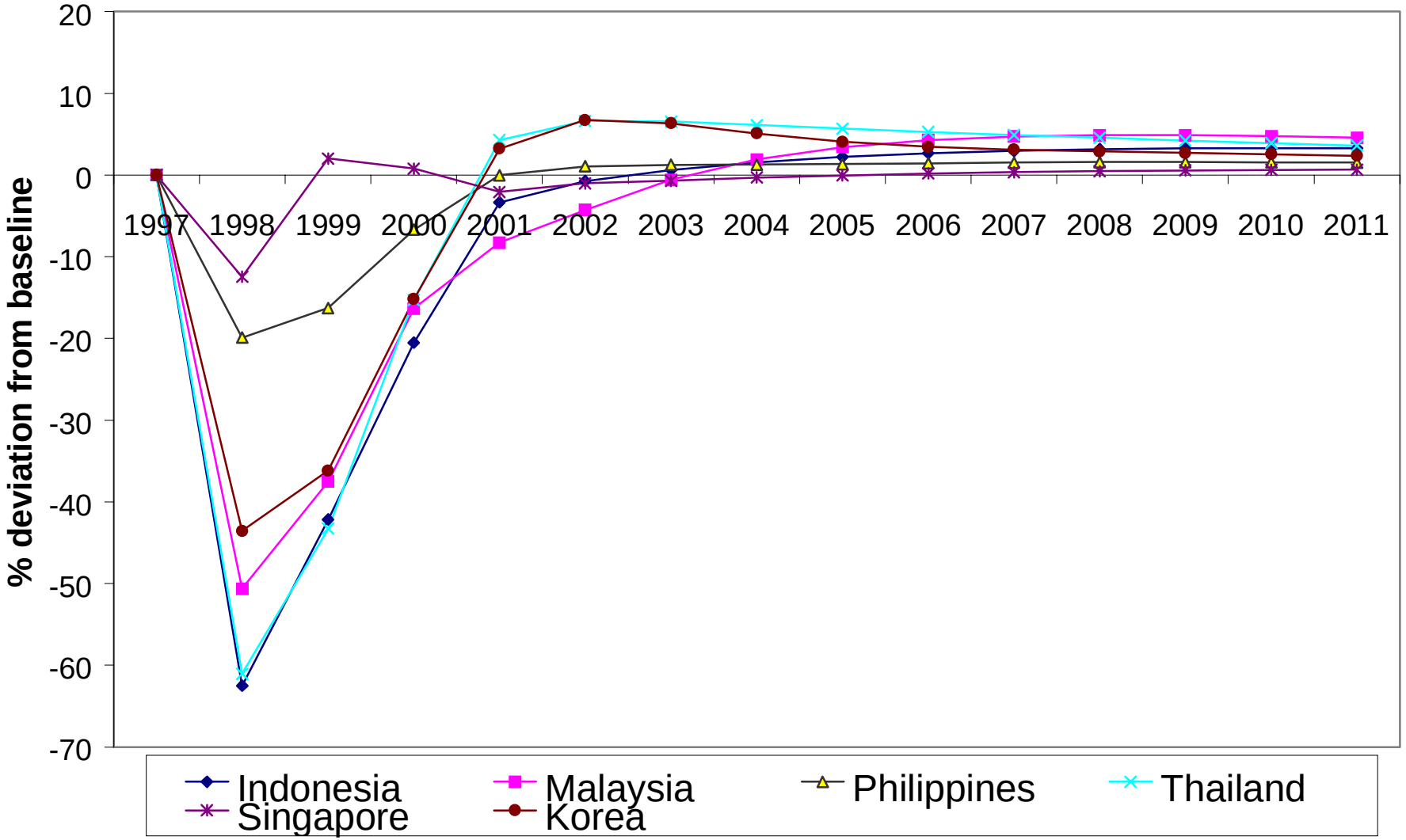


Figure 6: Change in Private Investment due to Temporary Loss in confidence

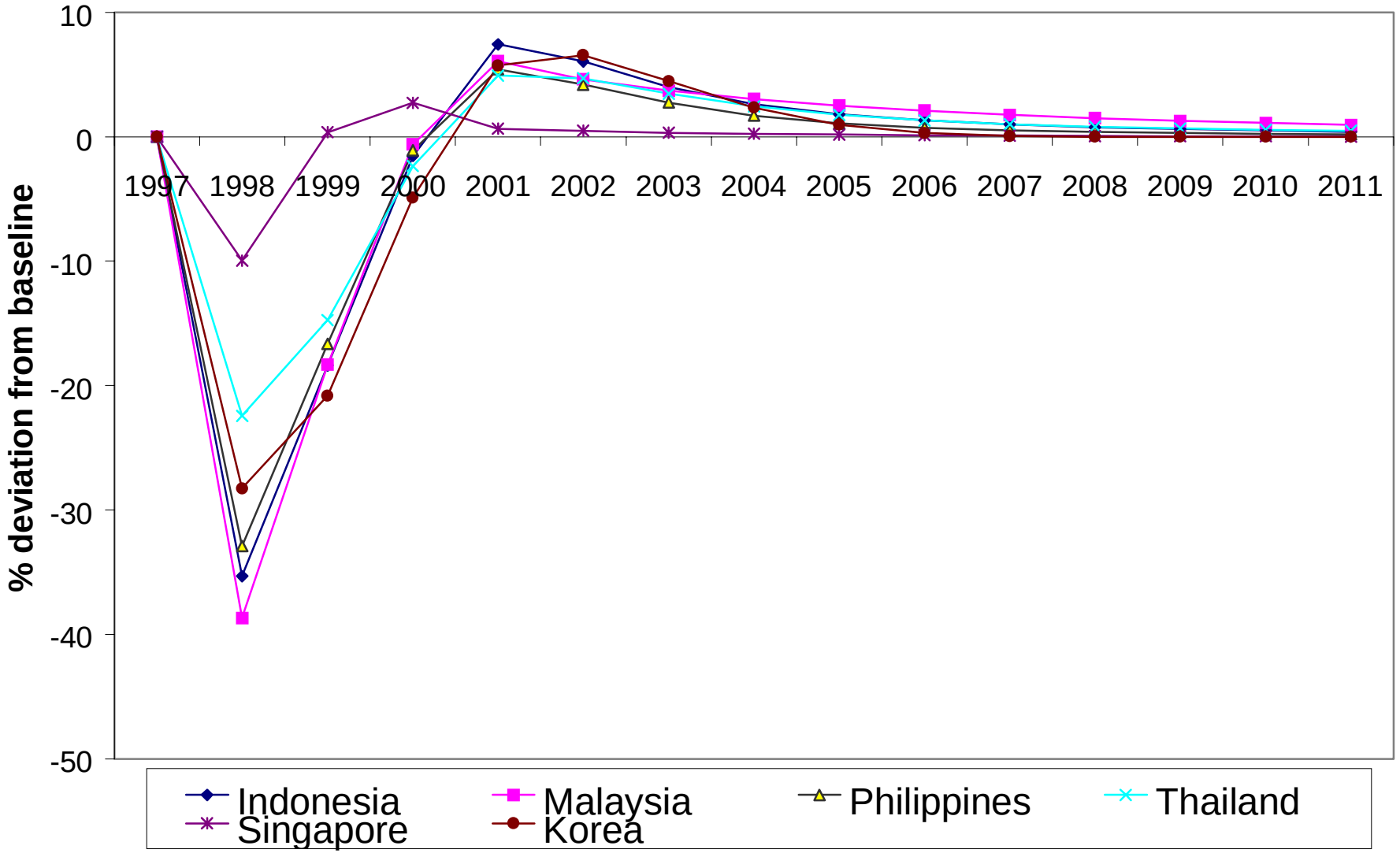


Figure 7: Change in Real GDP due to Temporary Loss in Confidence

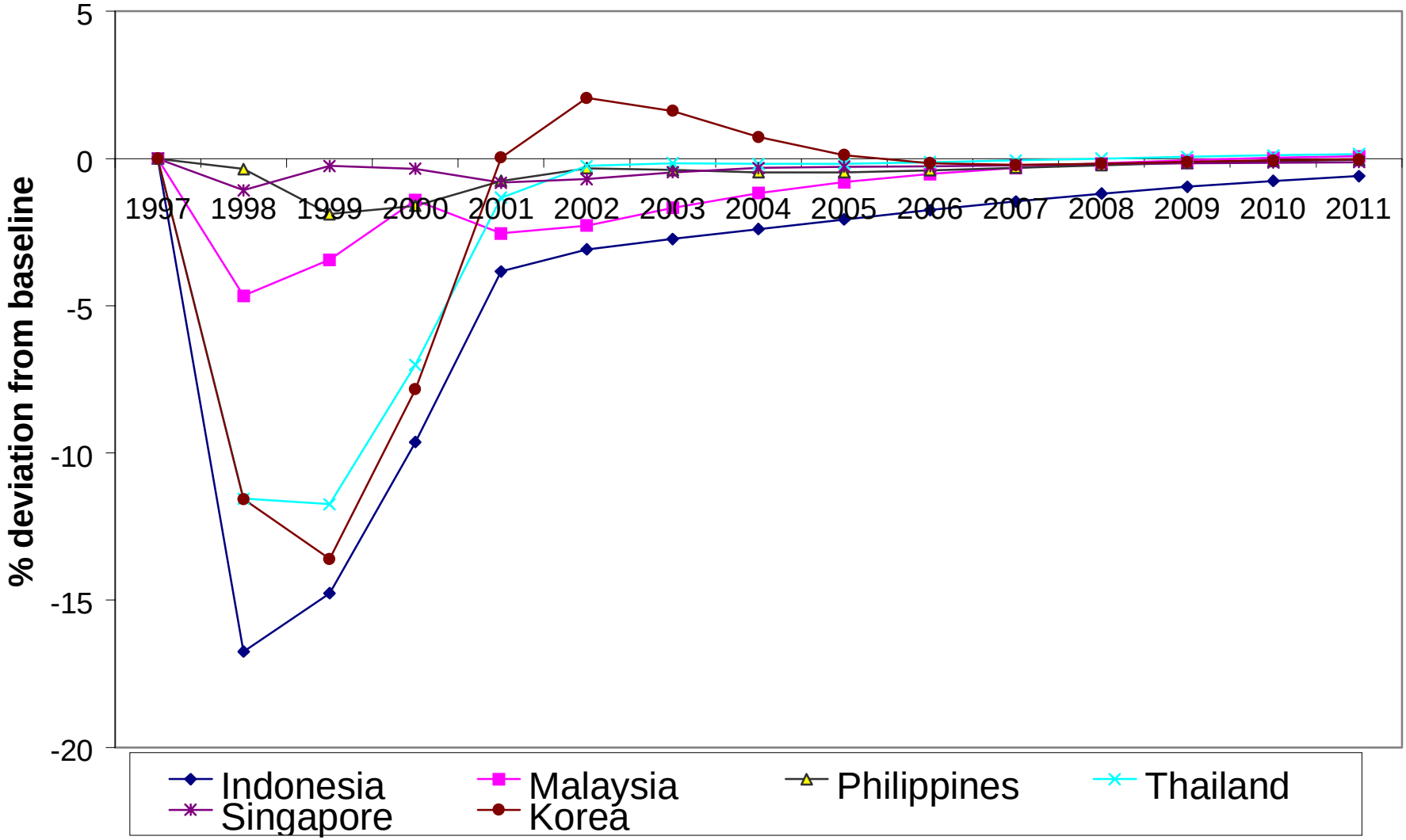


Figure 8: Change in Real Exports due to Temporary Loss in confidence

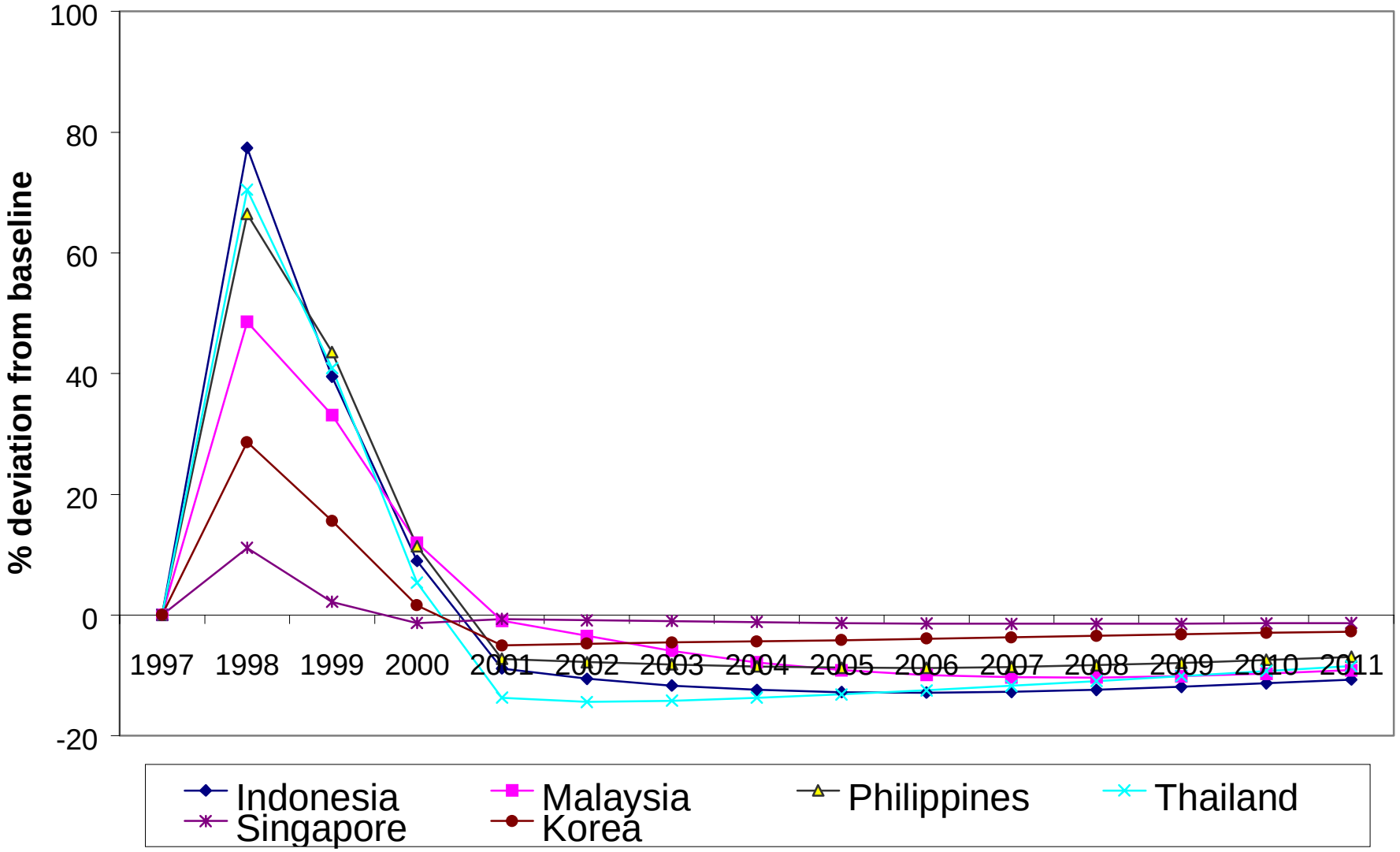


Figure 9: Change in Australian and US Current Accounts due to Temporary Loss in confidence

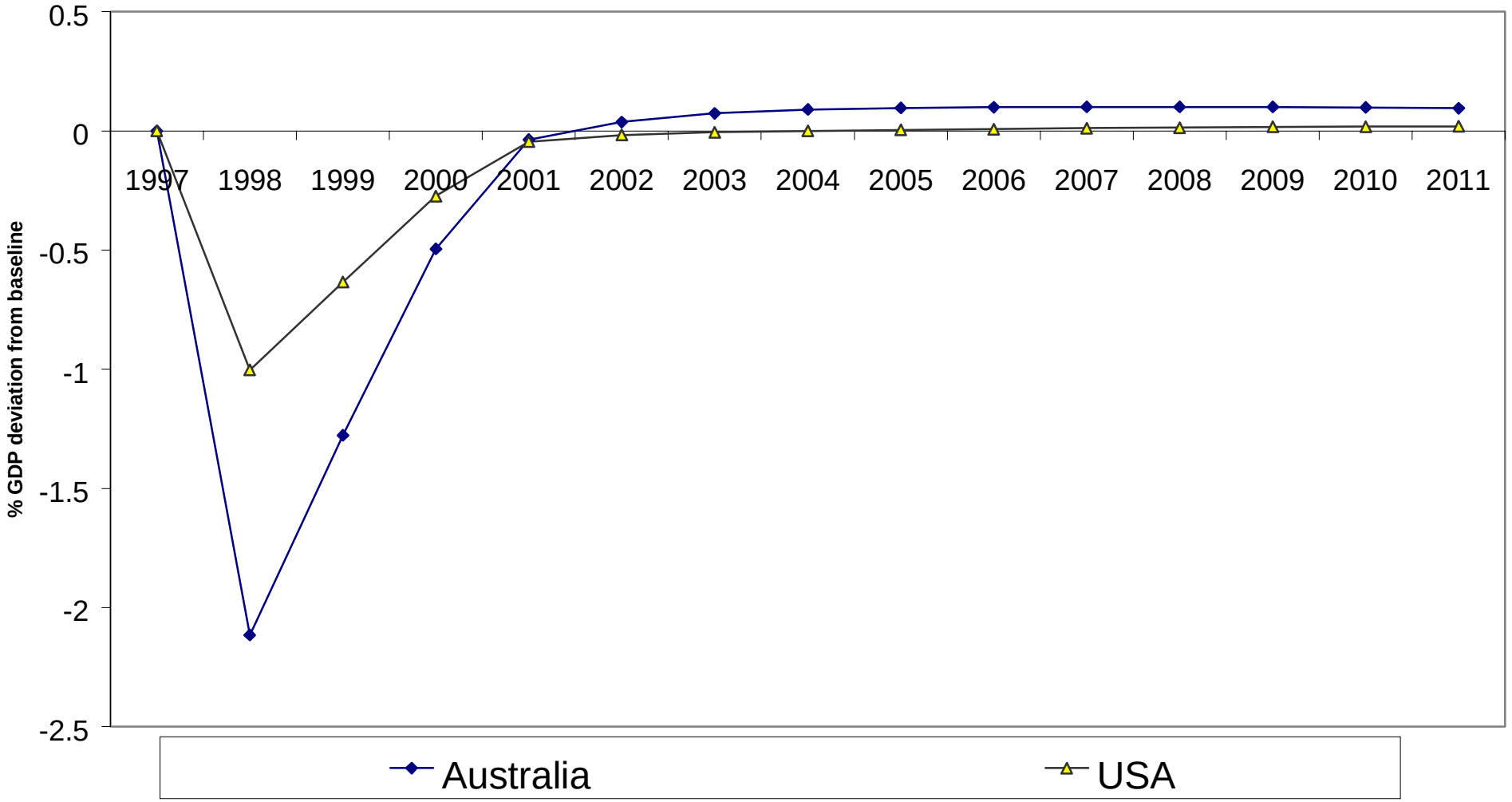


Figure 10: Change in US and Australian Exports and Investment due to Temporary Loss in confidence

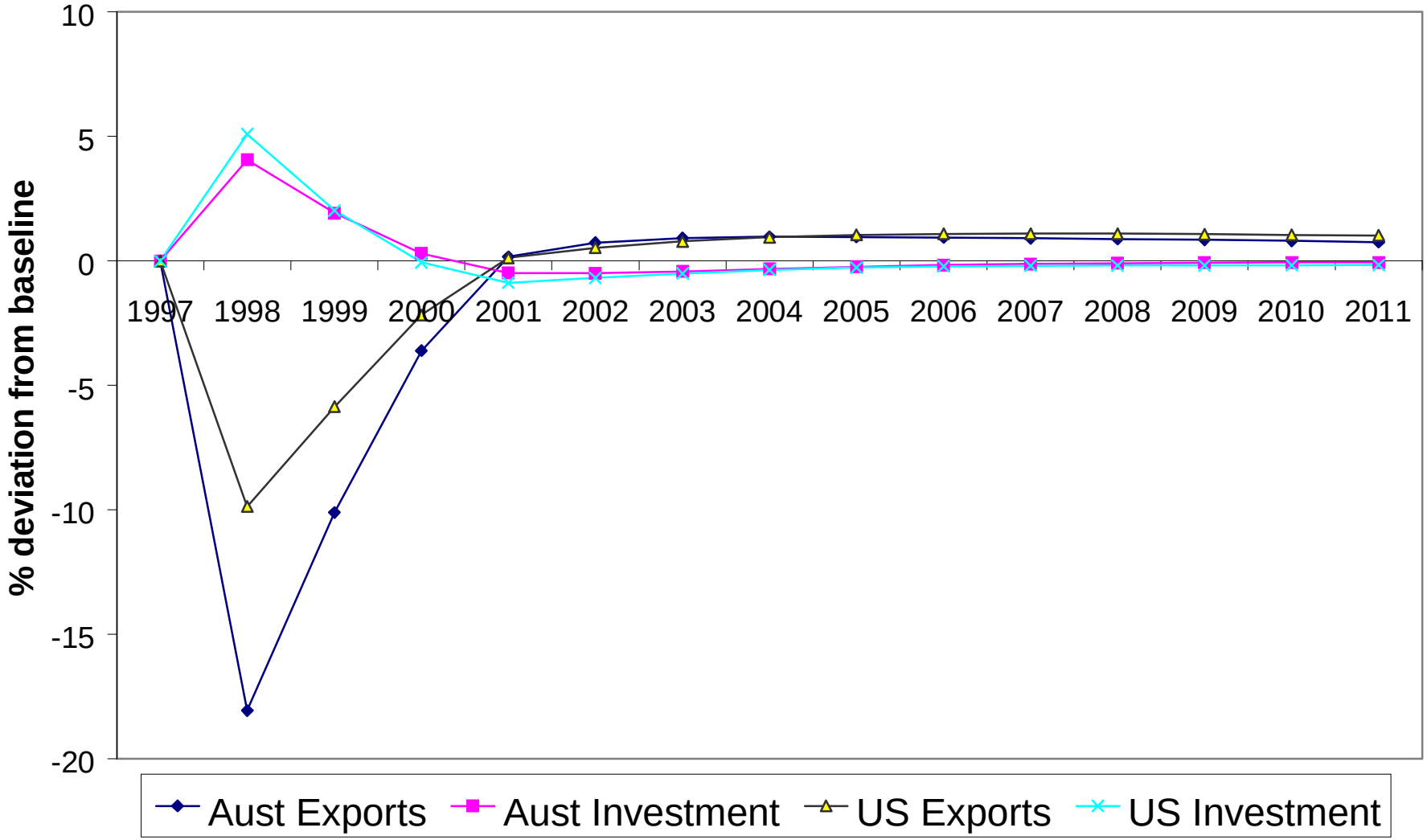


Figure 11: Change in Australian and US GDP due to Temporary Loss in Confidence

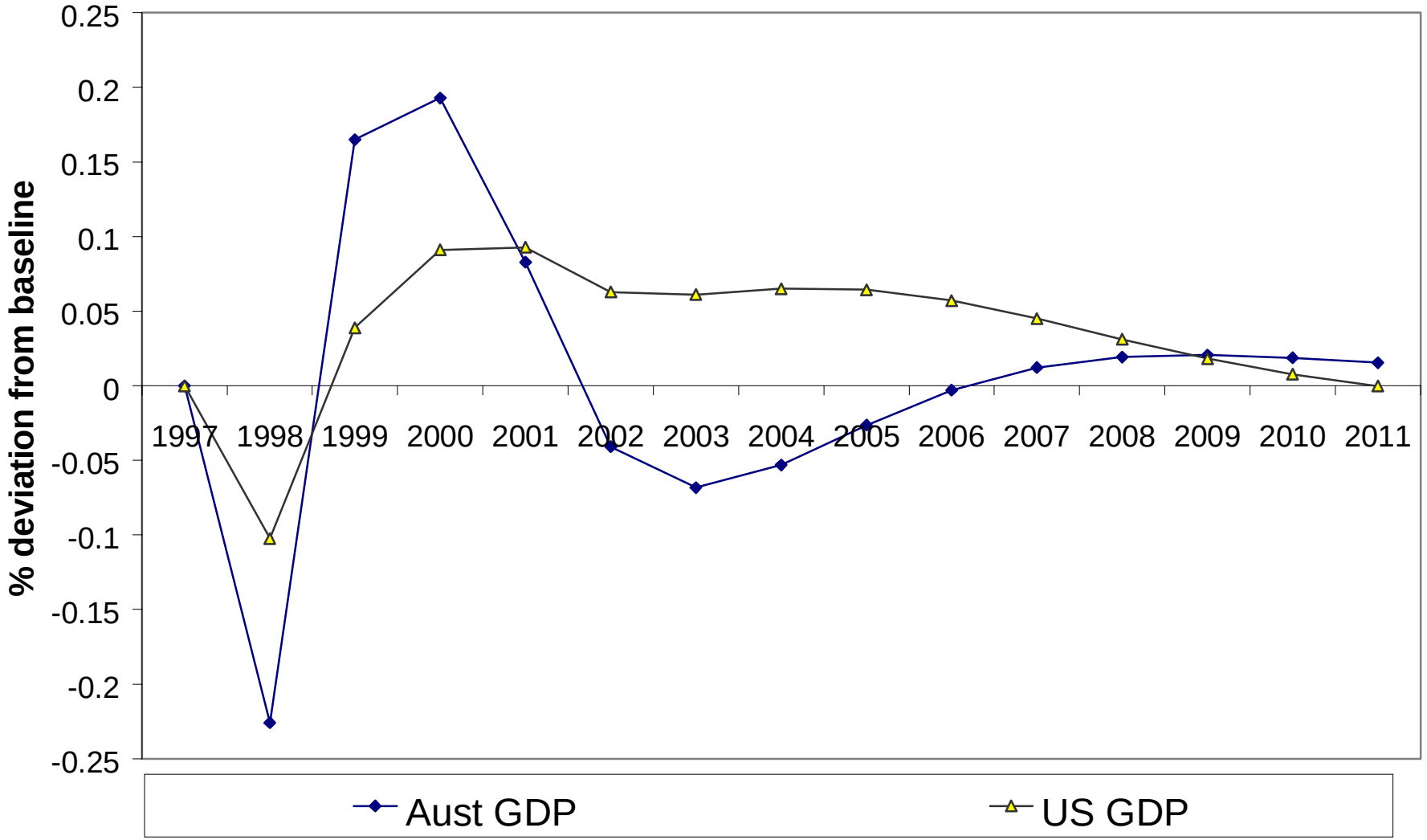


Figure 12: Change in Australian and US GNP due to Temporary Loss in confidence

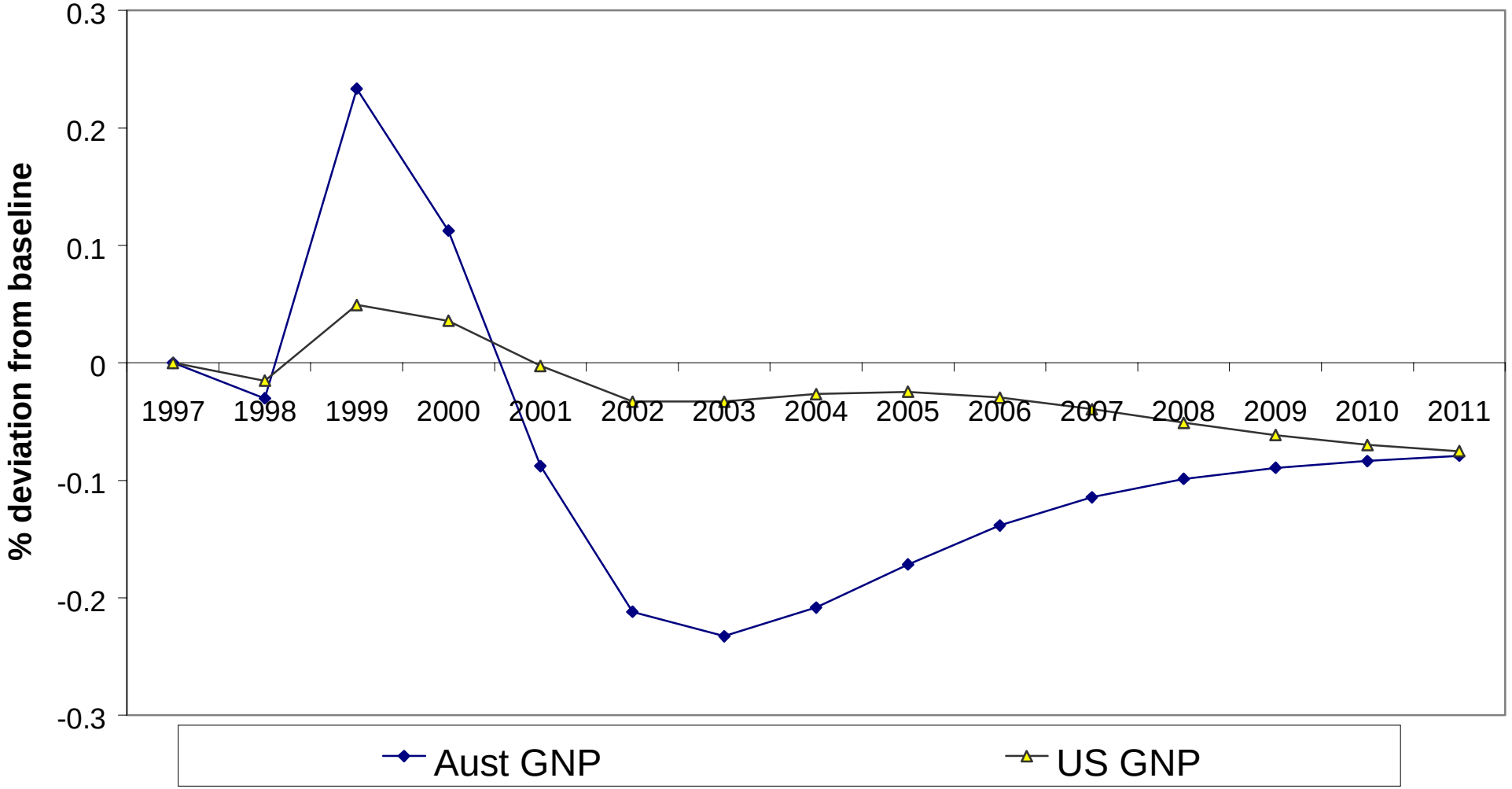


Figure 13: Change in Exchange Rates due to Permanent Loss in confidence (depreciation is down)

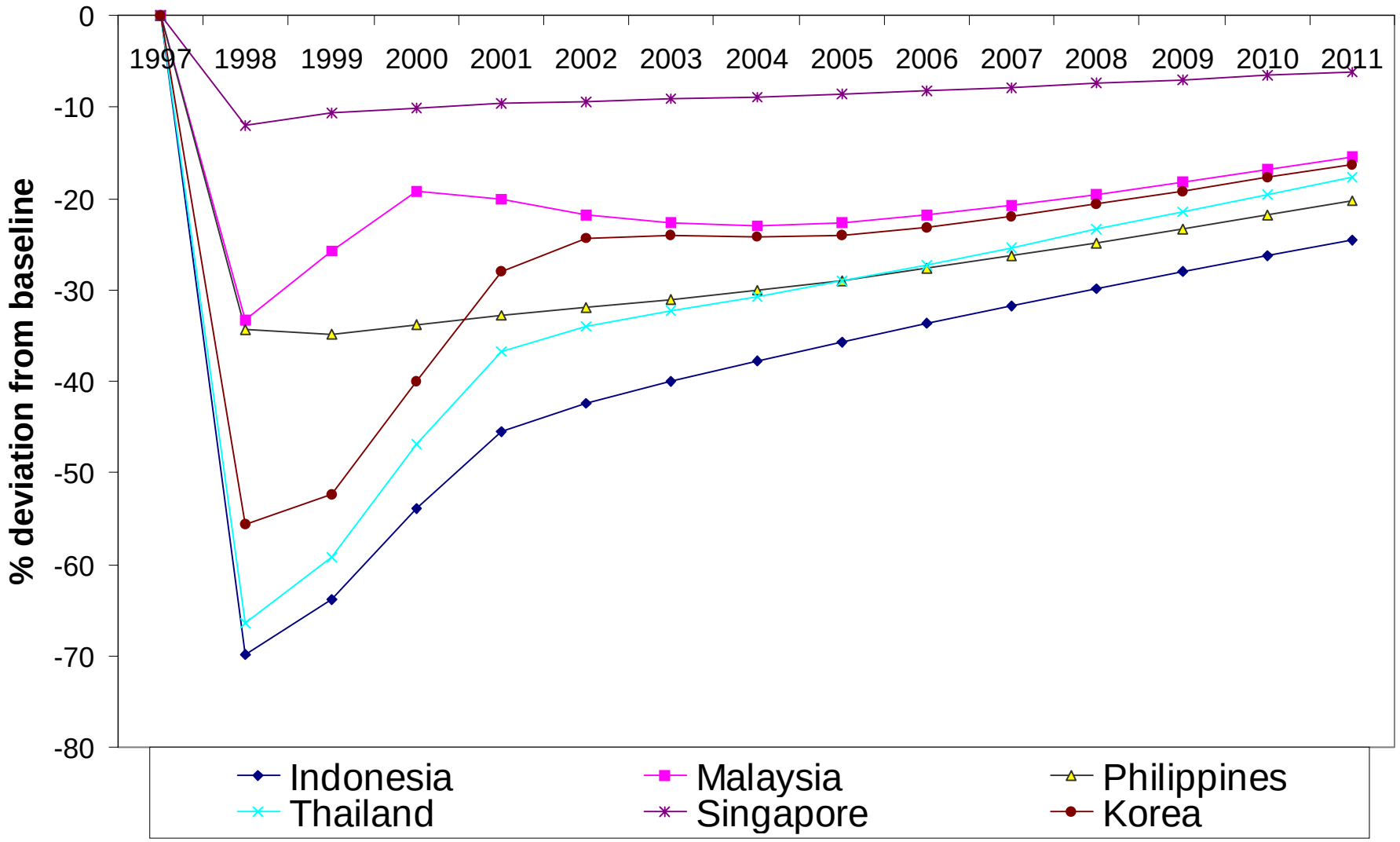


Figure 14: Change in Private Consumption due to Permanent Loss in Confidence

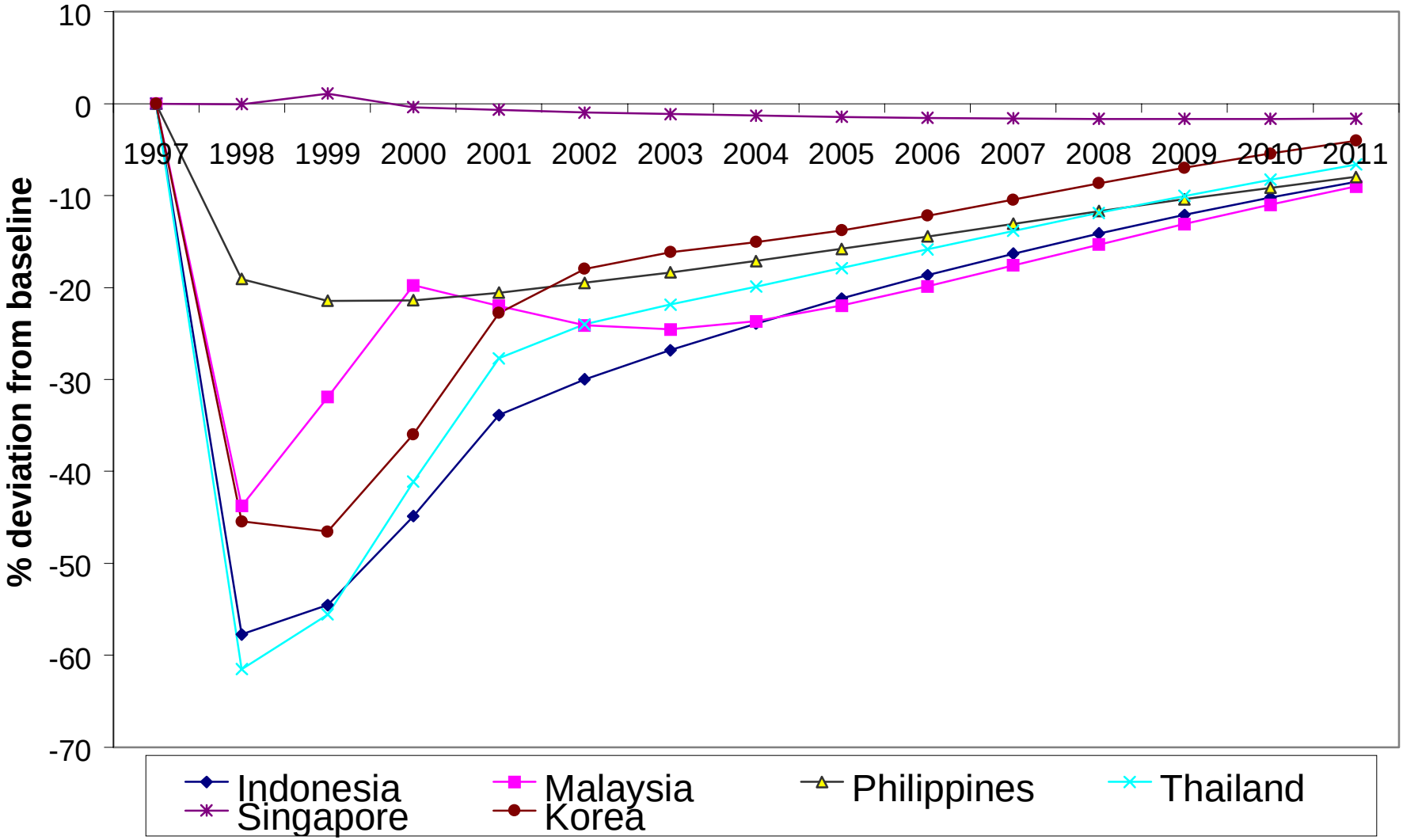


Figure 15: Change in Private Investment due to Permanent Loss in confidence

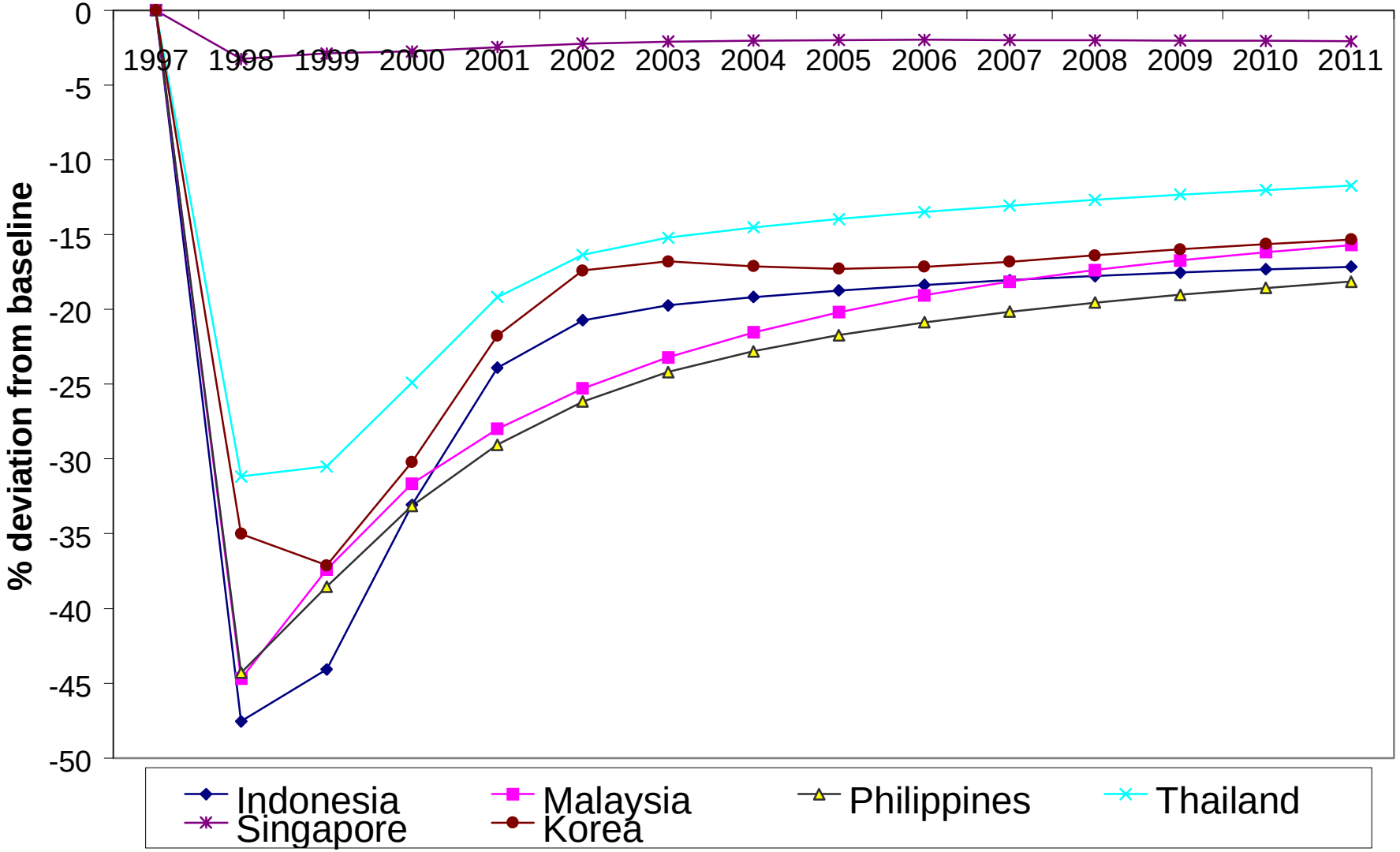


Figure 16: Change in Real GDP due to Permanent Loss in Confidence

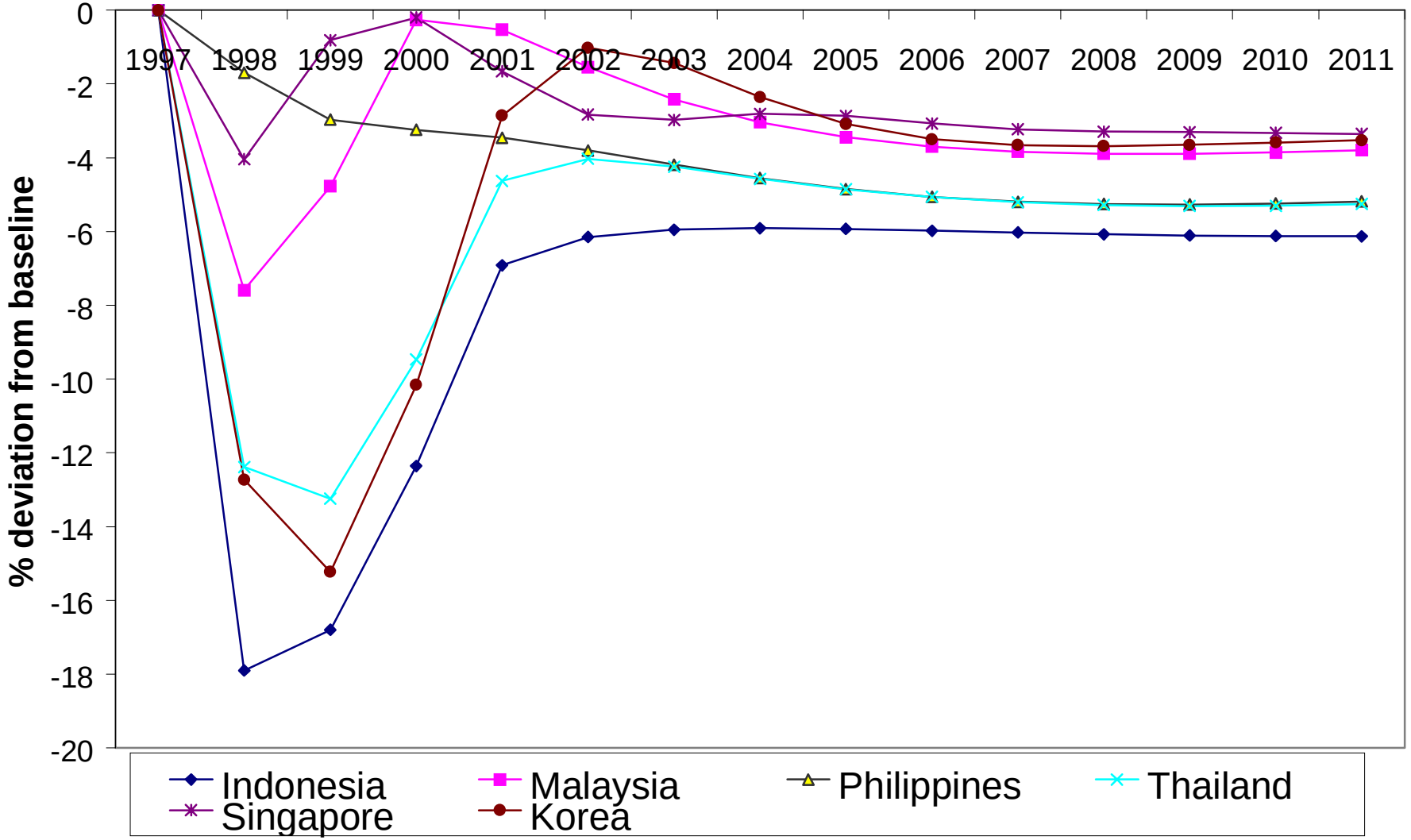


Figure 17: Change in Real Exports due to Permanent Loss in confidence

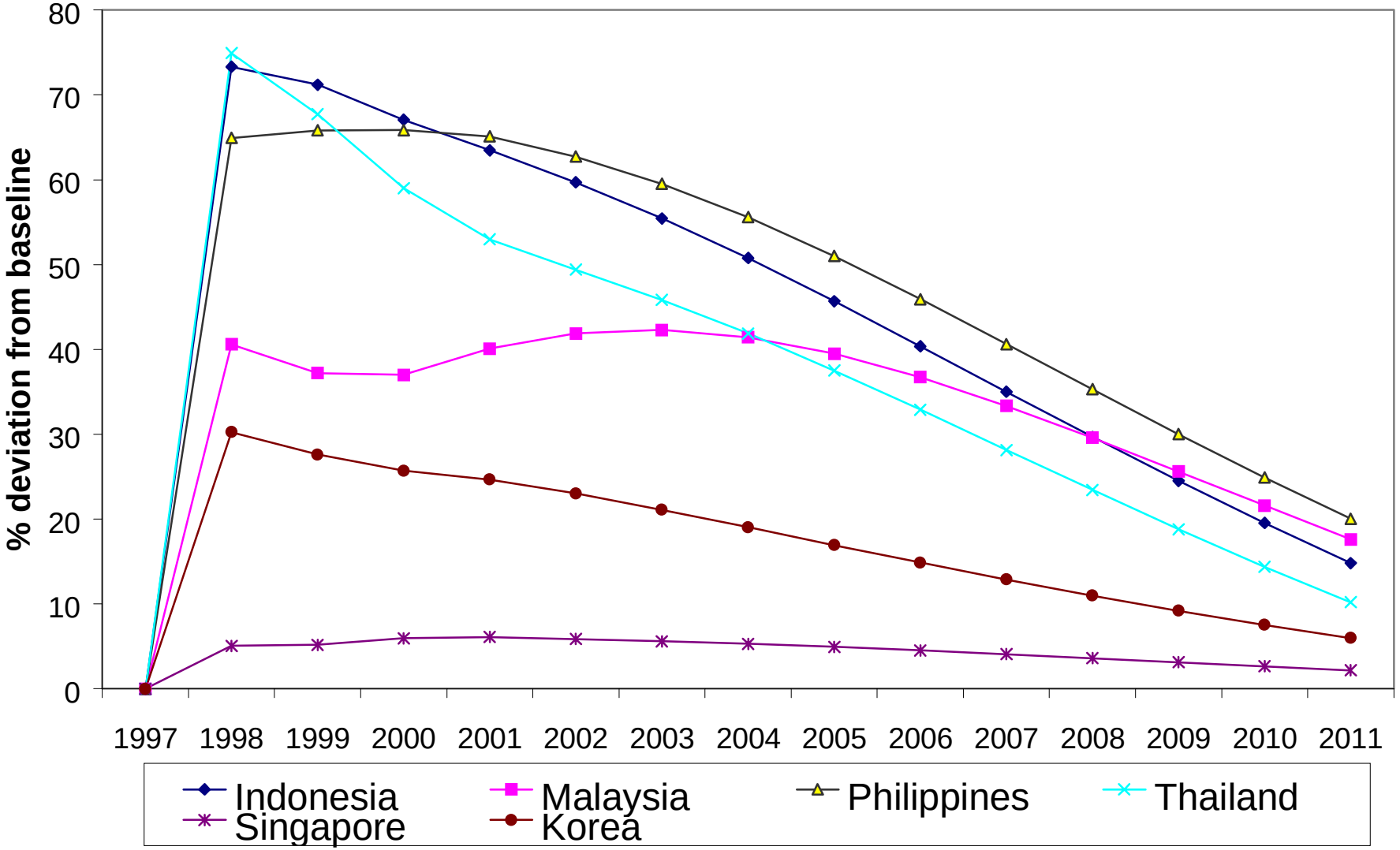


Figure 18: Change in Australian Dollar : Permanent versus temporary Loss in Confidence

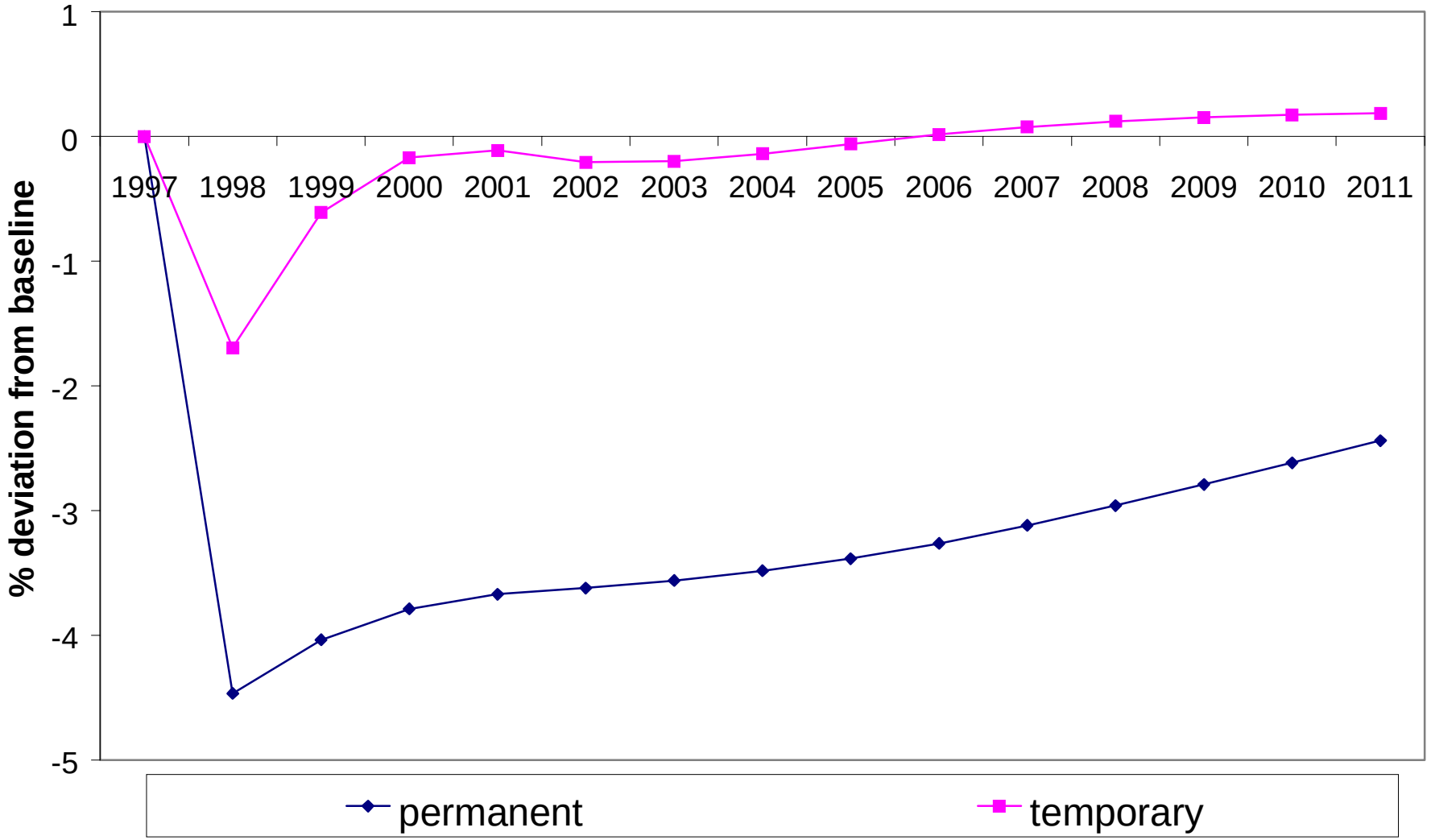


Figure 19: Change in US and Australian Exports and Investment due to Permanent Loss in confidence

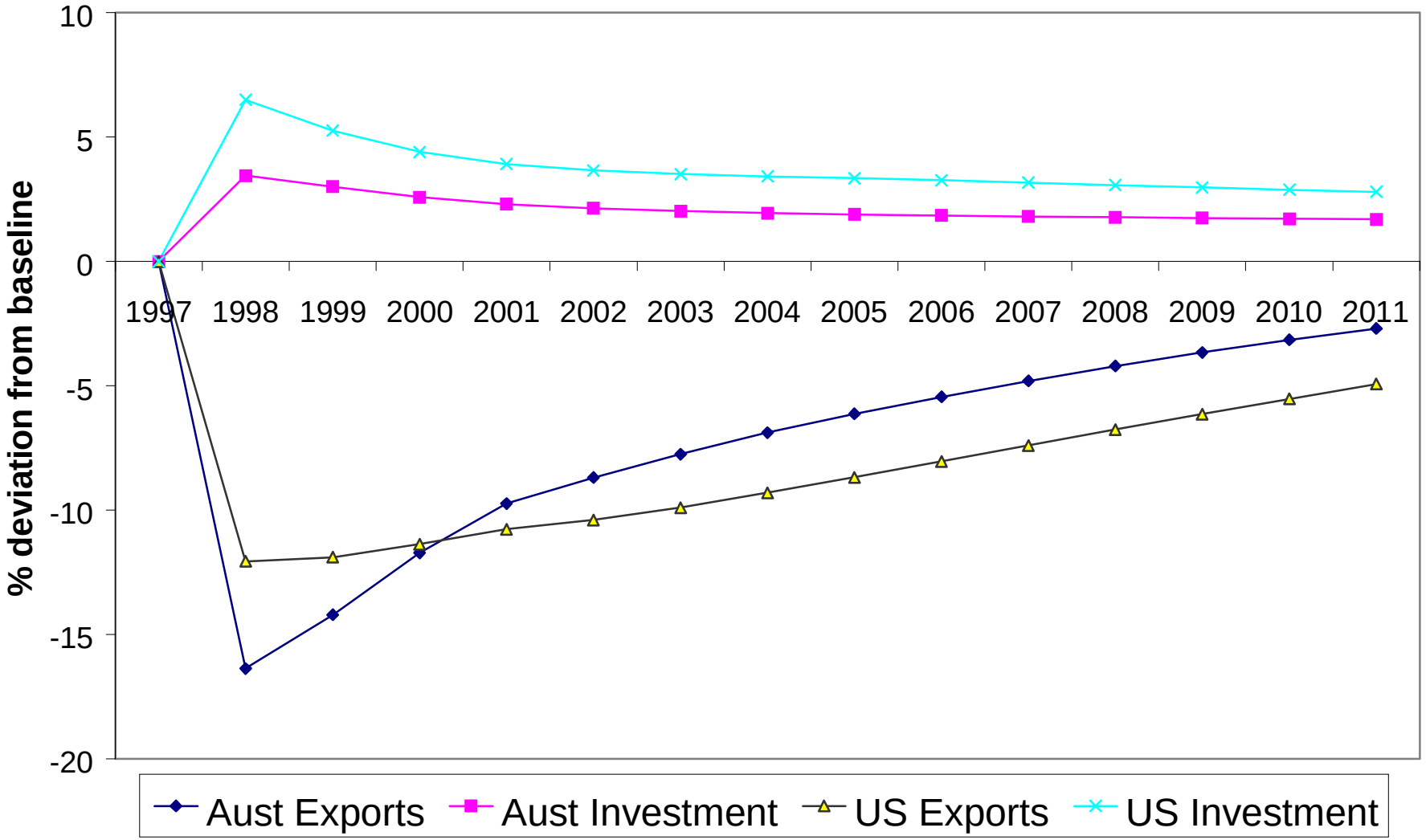


Figure 20: Change in Australian and US GDP due to Permanent Loss in Confidence

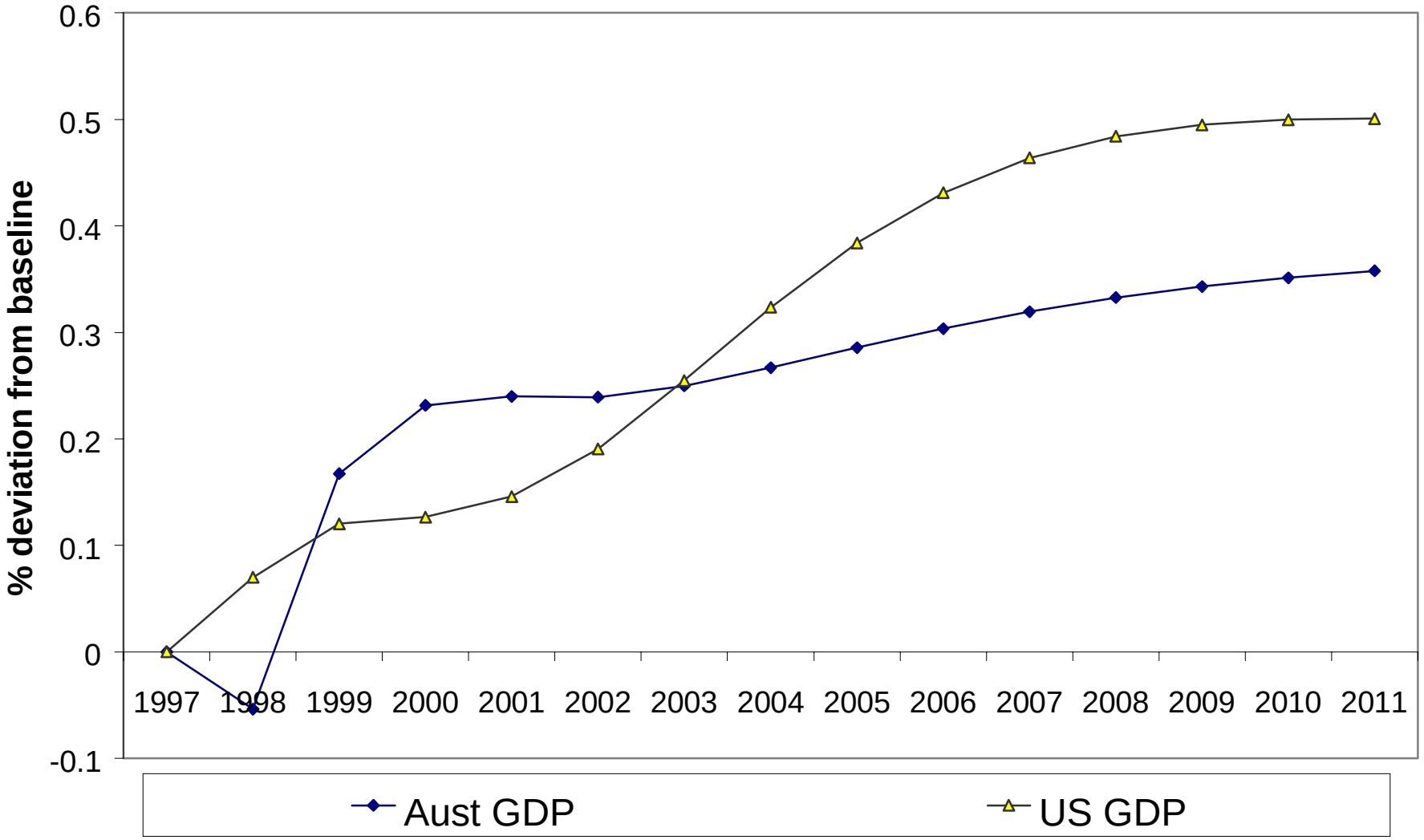


Figure 21: Change in Australian and US GNP due to Permanent Loss in confidence