A Quantitative Approach to Integrating Economic Analysis and Import Risk Assessment

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**The views presented are those of the authors and do not represent the official views of ABARE.*

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- A stochastic bioeconomic model of the potential costs of importation accounting for consumer benefit from trade
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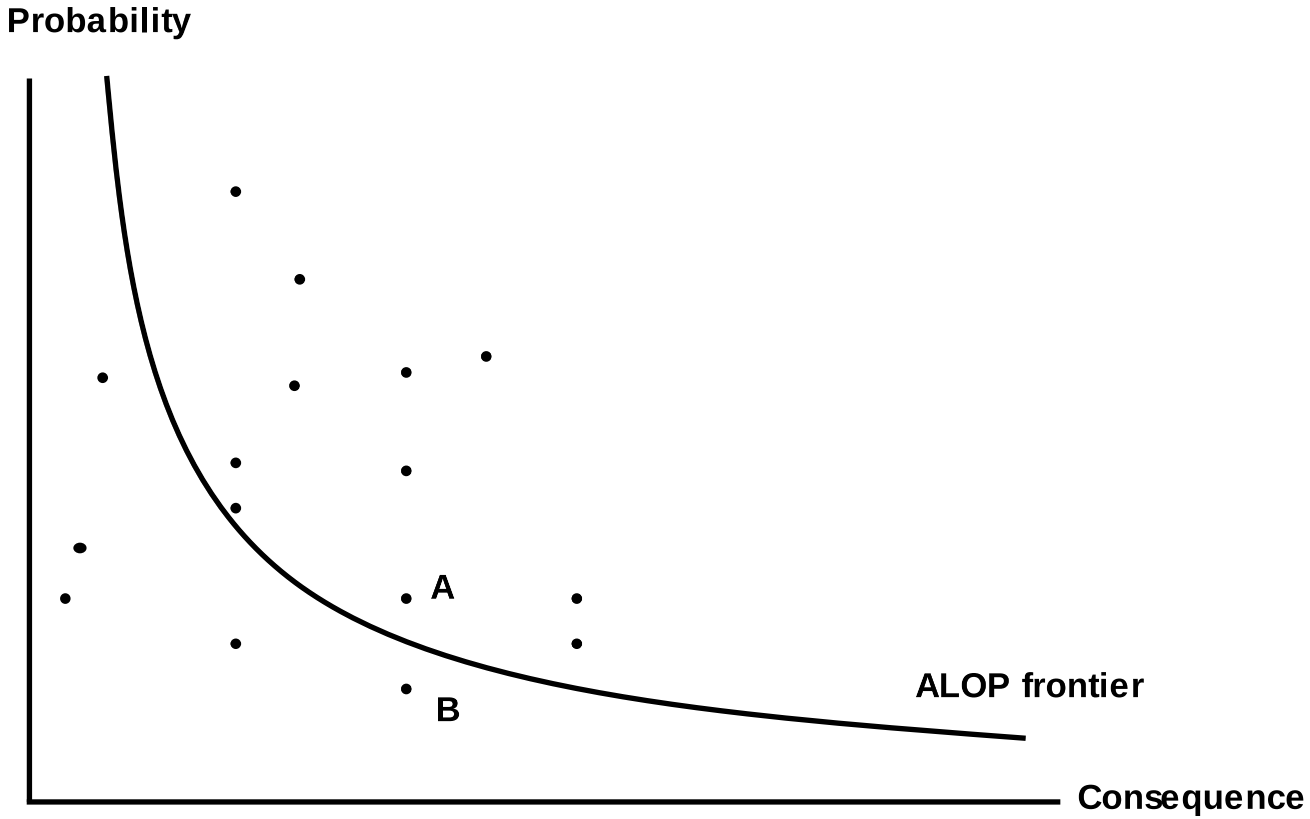
Introduction

- Australian agriculture heavily on international trade in agricultural products; and biosecurity measures provide an essential service, protecting agriculture, the environment and plant, animal and human health from dangerous invasive species.
- The WTO provides the right for countries to adopt measures necessary for the protection of human, animal and plant health.
- WTO measures are largely science-based, but require trade not to be unusually restrictive, arbitrarily or discriminatory.
- ‘Appropriate Level of Protection’ (ALOP) standards should require that “quality ‘economic consequence studies’ be incorporated in import risk analyses” (Beale Review 2008)
- There is a growing need for qualitative analysis of the ‘economic consequence’.

Import risk and consequence



- Source: *Adapted from Beale et.al. (2008).*

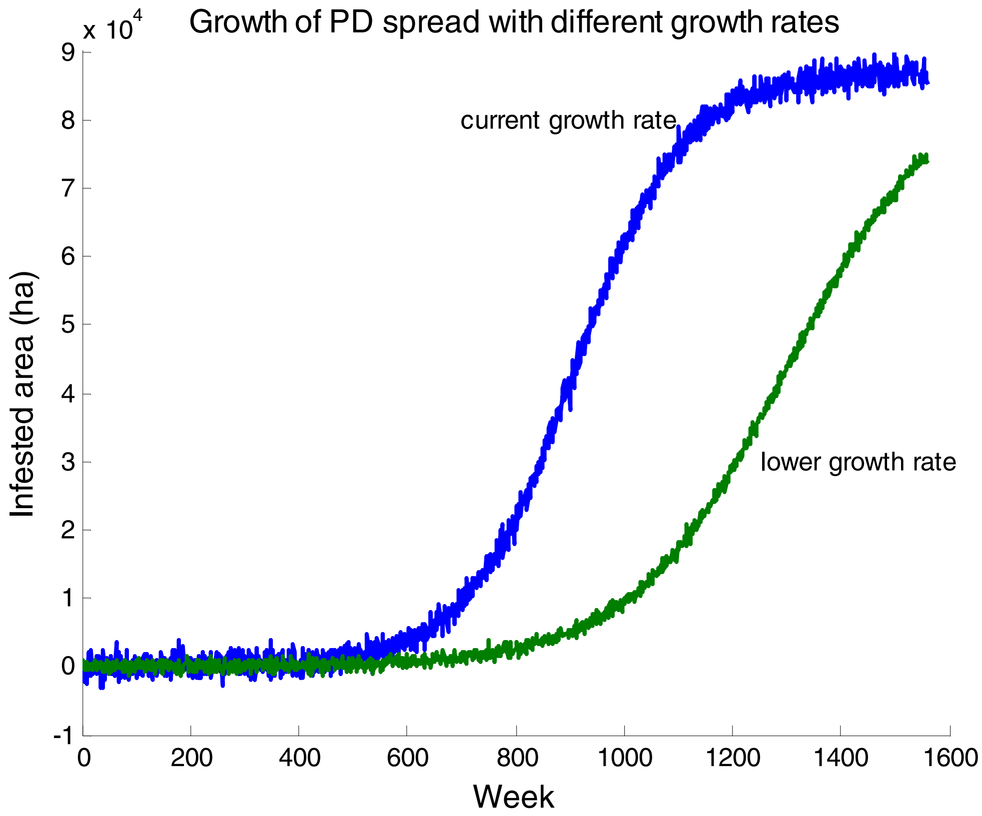
Benefit and cost of pre-border quarantine measure

- **Benefit**: saving the potential costs caused the risk of a potential development of an exotic invasive species, which depends on:
  - Risk of entry, establishment and spread
  - Biological parameters of area or population and density growth, the growth rate and maximum carrying capacity
  - Economic value of the accumulated marginal costs of the invasive species (e.g., damages to agricultural production, the environment and animal, plant and human health, along with losses in potential trade and market access, the management costs of the invasive, etc.)
- **Cost**: administrative costs and the loss in consumer surplus from quarantine through higher prices of agricultural products, and potentially less variety and lower quality goods.

A generic stochastic bioeconomic model

- **Risk of outbreak and development**:
  - Probability of entry: quantity and spatial distribution of the invasive; and effectiveness of the quarantine system; and import volume
  - Probability of establishment: suitability of environment; potential adaptation; capacity of survival; cultural practices
  - Probability of spread: suitability of environment; extent of natural barriers, potential movement, conveyances
- **Growth model**: Logistic, Markov spread, etc. Also depends on the initial infected population *N(0);* the growth rate *g;* maximum carrying capacity *Q(max);* and uncertainty.
- **Potential economic impacts**
- **Potential environmental or human health impacts**

Stochastic logistic growth model



A stochastic bioeconomic model

- A stochastic bioeconomic model (time dependent) of the potential costs of an invasives entry and development as a potential import risk

$$TC(t) = \sum_{t=0}^{T} f(p, Q(t), C_P, C_M, C_T, C_O, \zeta)$$

- A stochastic bioeconomic model of potential costs of importation, net costs accounting for the gain in consumer surplus with imports

$$NTC(t) = TC(t) - CS(p_W, p_D, V)$$

- Net Present Value: using the appropriate discount rate

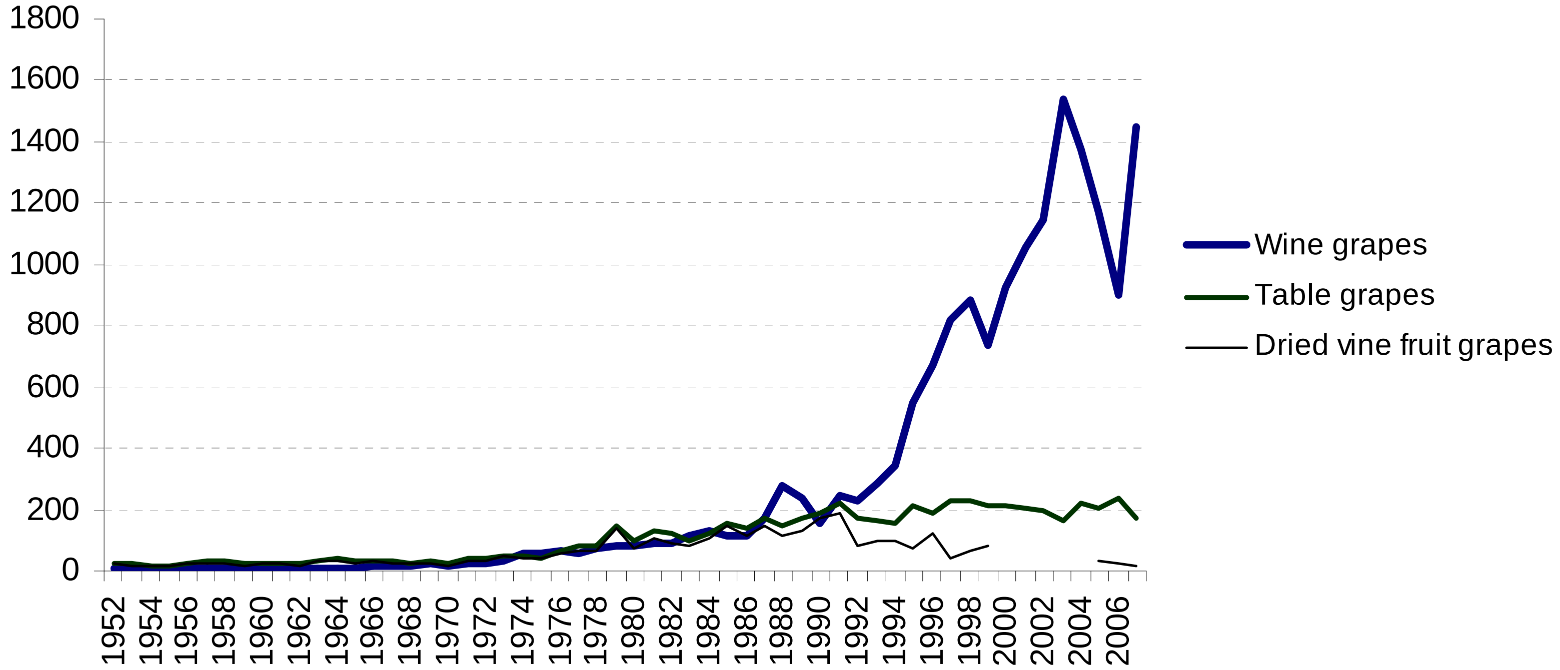
Example: Potential threat of Pierce's disease

- Pierce's disease (PD) caused by the bacterium *Xylella fastidiosa*: a destructive disease on the grapevine and for other horticulture industries
- The bacterium causes a gel to form in the xylem tissue of the vine; leaves will turn yellow and brown and eventually drop off; shoots will also die; the vine itself will die after 1 to 5 years
- No effective treatment for infected vines. Containment is through treatment by antibiotic material (Hopkins and Mortensen, 1971)
- Cost caused by PD in Southern California was estimated to be hundreds of millions of dollars (McDonald, 2002)
- Estimated costs of roughly U$100 million for the orange industry in Sao Paulo State, Brazil in 2000 (Li et al. 2002)
- PD has spread rapidly in the USA since 1990s because of (i) the shift from the broad spectrum to more narrowly active insecticides; and (ii) the advent of the glassy winged sharpshooter (GWSS) (Scott and De Barro, 2001)

Symptom on leaf of infected grapevine

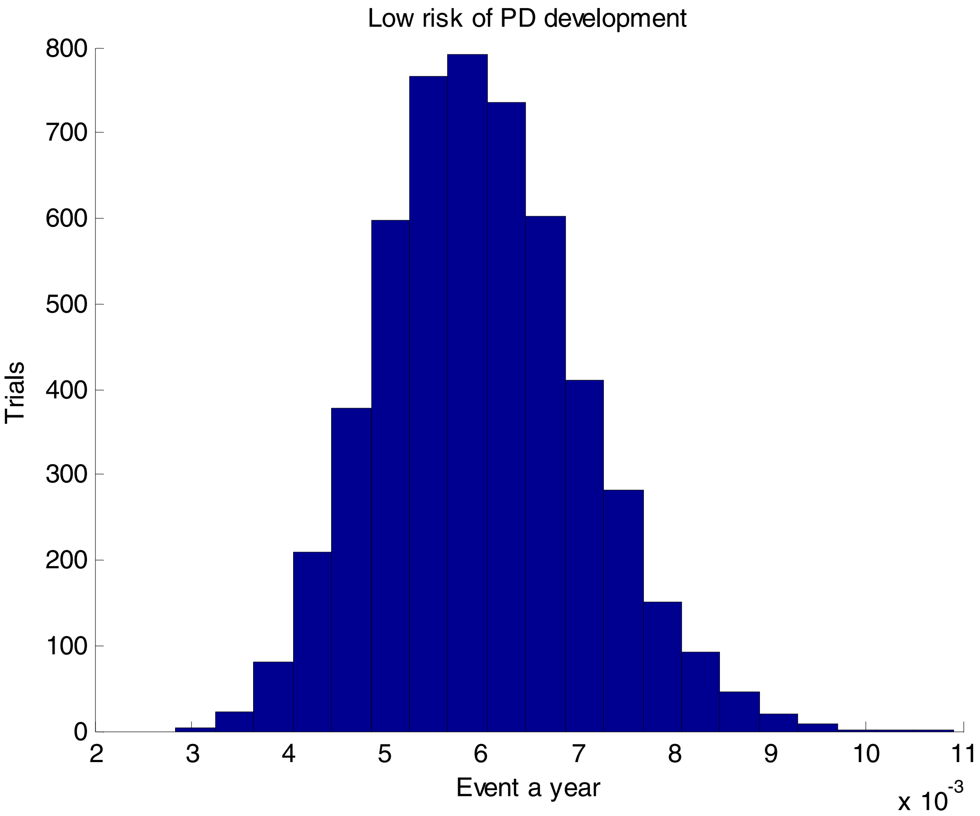
Appearance of glassy-winged sharpshooter

Gross value of production of the Australian viticulture industry *(A$/mil)*

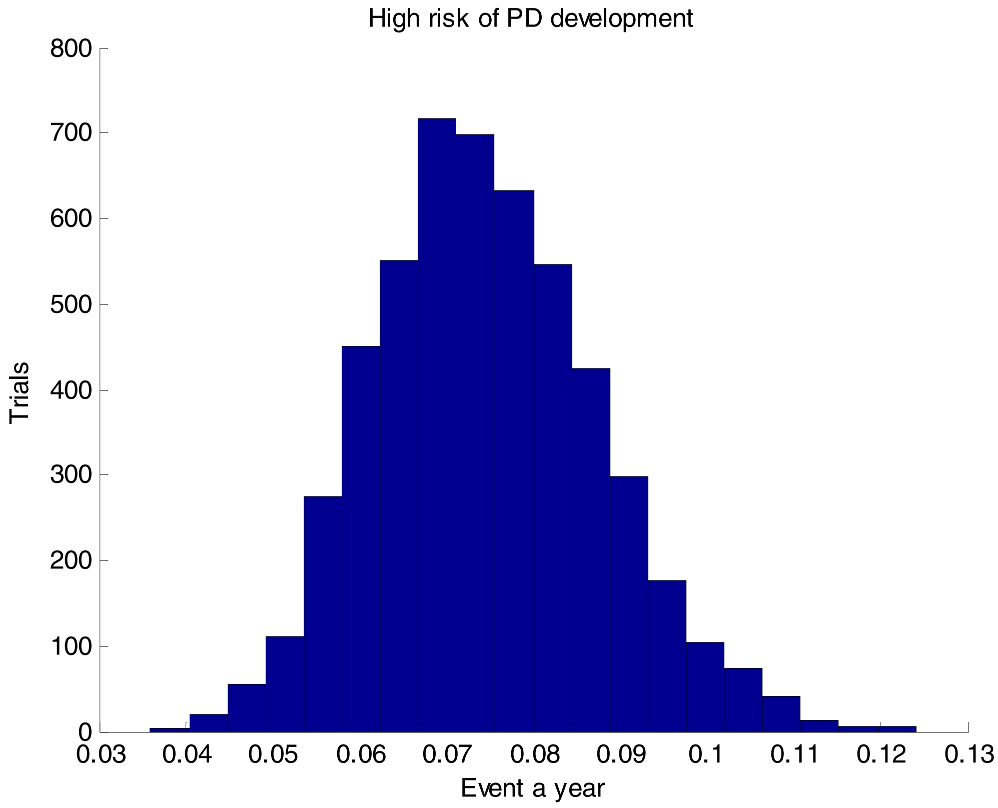


Source: Australian Bureau of Statistics (ABS), 2009

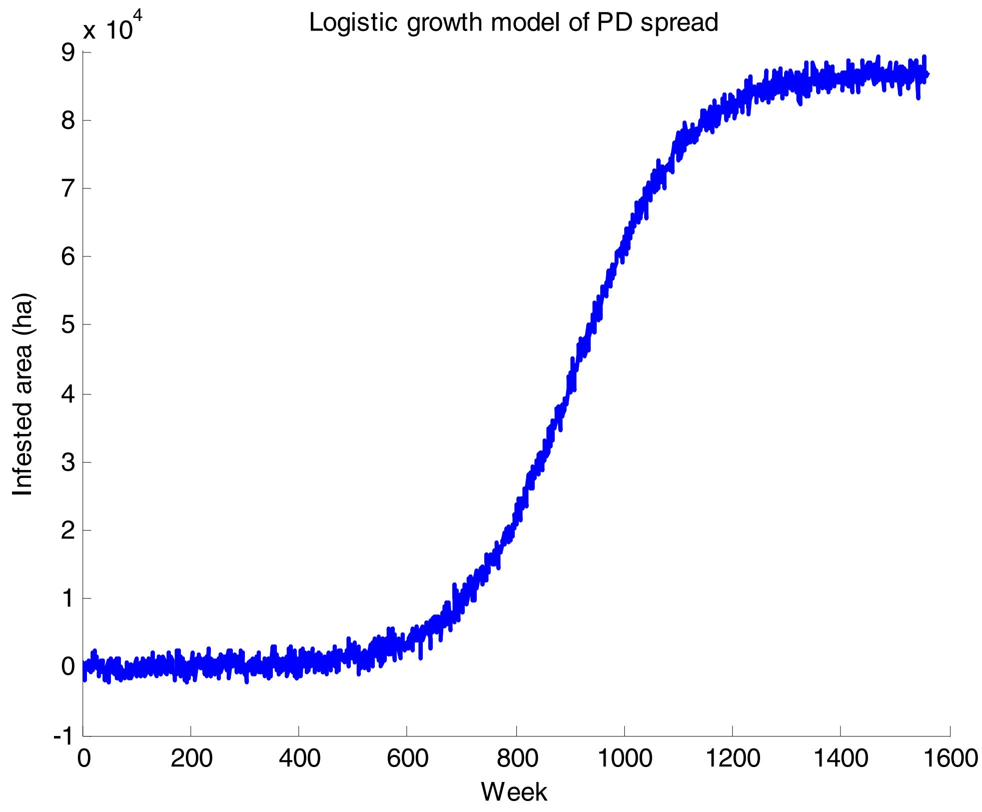
Low risk of PD growth



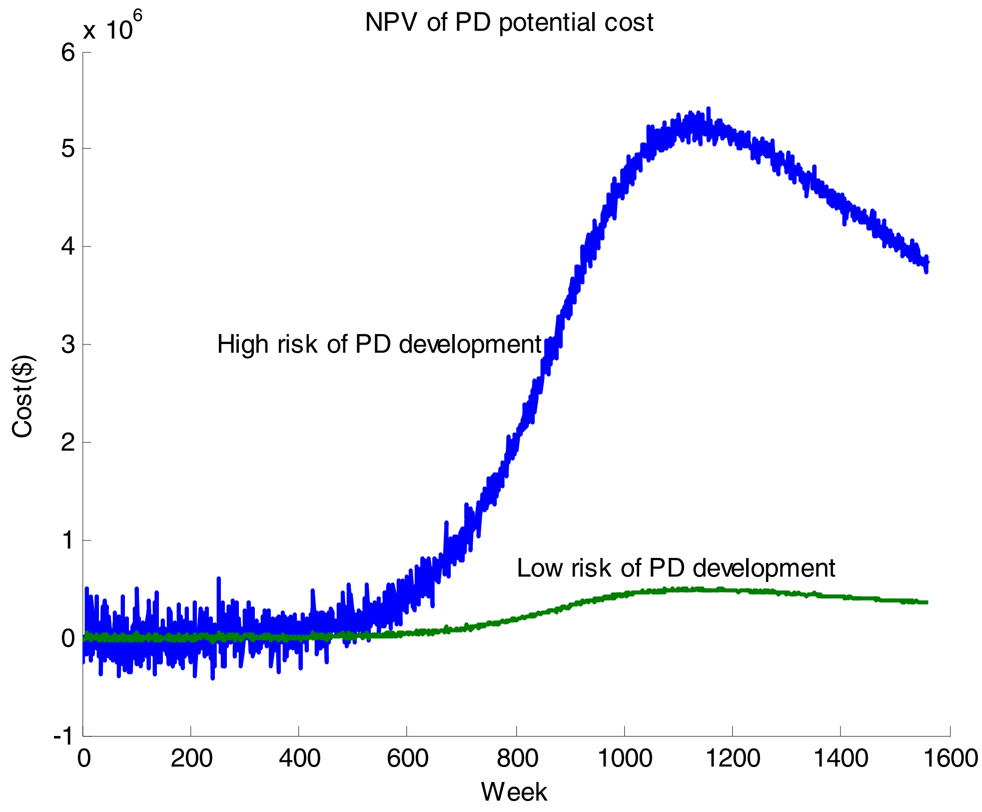
High risk of PD growth



Logistic growth model of PD spread



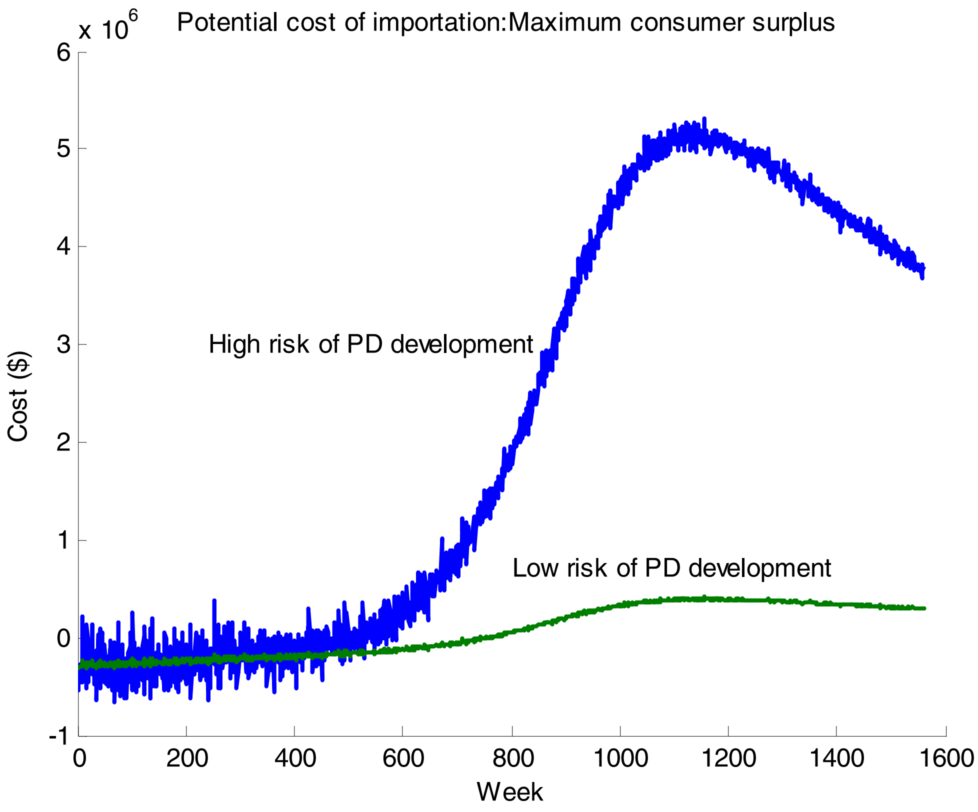
NPV of potential cost of PD (δ=5%/year)



NPV of potential cost of PD *(δ=5%/year)*

Risk of development	Probability *(event/year)*	NPV of potential cost *($mil/year)*
Low risk	~N(0.006,0.001)	10.1
High risk	~N(0.08,0.01)	120.1

Potential cost of importation: maximum consumer benefit *(δ=5%/year)*



Potential cost of importation of table grape *(δ=5%/year)*

Risk of PD development	Probability *(event/year)*	NPV of potential *($mil/year)*
Case 1: Minimum Consumer Benefit *($1.5/kg)*		
Low risk	~N(0.006,0.001)	2.4
High risk	~N(0.08,0.01)	**112.3**
Case 2: Maximum Consumer Benefit *($3.5/kg)*		
Low risk	~N(0.006,0.001)	**-5.4**
High risk	~N(0.08,0.01)	104.5

Closing Remarks

- This study presents an quantitative approach to integrating economic analysis and import risk assessment.
- The model takes into account both uncertainty over the risk of introduction and spread and resulting economic damages
- PD is used as an illustrative example. NPV of potential cost of table grape importation for the high risk and the minimum consumer benefit is $112 million/year; for the low risk and the maximum consumer benefit is -$5.4 million/year.
- The estimated results are subject to change due to changes in the risk assessment and other biological and economic parameters.
- Quantitative economic analysis can be demanding in terms of data requirements and involve complex techniques, expert knowledge and judgment.
- Limited information can affect the quantitative analysis of risk and economic analysis (Binder, 2002), increasing the bounds of uncertainty.